PUBLIC WORKS

April

CITY, COUNTY AND STATE

SUPPLYING WATER for 7,000 Additional Services per Year page 85

Basic Principles for the Design of RIGID PAVEMENTS page 92

Suggestions for BETTER MANAGEMENT of Sewage Treatment Plants page 104

Municipal Experiences with COMPACT CARS page 109

PACKAGE PLANTS for Sewage Treatment at the Sub-Municipal Level page 111

Complete List of Articles and Features on page 5



Albert B. Kaltenbach is Director of the Department of Public Works for Baltimore County, Maryland. His department provides all public facilities for this fast-growing urbanized county. More on page 18.

Wedge-Lock® JOINT Full Circle MINIMUM PROTECTION **ROOT-TIGHT** INFILTRATION! SEAL!



FAST INSTALLATION!

When you install Vitrified Clay Pipe with Wedge-Lock Factory-Made Joints, you leave nothing to chance. Wedge-Lock pre-cast Joints are bonded to bell and spigot . . . snap together instantly . . . seal the entire circumference of the pipe to reduce infiltration and resist roots. Always specify Wedge-Lock, your Full Circle of Protection against infiltration . . . root problems . . . job delays . . . ultimate high cost resulting from costly repairs or maintenance.

Write to listed manufacturers for literature or an actual Wedge-Lock demonstration

Wedge-Lock CLAY PIPE

THE FACTORY-JOINTED CLAY PIPE AVAILABLE NATIONALLY FROM LOCAL MANUFACTURERS

Order Wedge-Lock from any of these Vitrified Clay Pipe Manufacturers:

Cannelton Sewer Pipe Company, Cannelton, Ind. The Clay City Pipe Company... Uhrichsville, Ohio Graff-Kittanning Clay Products. Worthington, Pa. Larson Clay Pipe Company......Detroit, Mich. Lehigh Sewer Pipe & Tile Co.....Fort Dodge, Ia.

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SEALED

The Logan Clay Products Company.. Logan, Ohio Owensboro Sewer Pipe Company. Owensboro, Ky. Pomona Terra-Cotta Company, Greensboro, N. C. The Robinson Clay Product Company. Akron, Ohio Superior Clay Corporation.... Uhrichsville, Ohio



The BARMINUTOR Screening and Comminuting Machines provide continuous, complete, automatic comminution . . . at lower operating and maintenance cost than any similar device today.

Barminutor

The BARMINUTOR was developed to provide greater flexibility and wide application of comminution . . . developed from the original "Chicago" COMMINUTOR, * proven highly successful in thousands of installations.

COMMINUTING MACHINES

BARMINUTOR Screening and Comminuting Machines eliminate unsightliness, nuisance and odor by continuously and automatically screening and cutting coarse sewage material without removal from the flow. Power requirements are lower than that required for mechanically raised screens and grinders. Manual attention is needed only for periodic inspection

and lubrication.

THE NEW MODEL "A-1" BARMINUTOR®

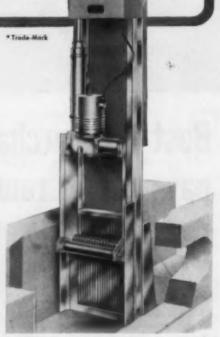
... with All Electric Drive

- Extra cutting capacity without increase in power
- · Shear bars allow additional cutting for peak loads
- Shear bars eliminate accumulation of rags and sewage solids on the screen
- Ball Bearings Shoes last longer . . . thereby greatly reducing maintenance
- Eliminated hydraulic hoses
- . Neat, compact drive motor and panel

A DEVELOPMENT
OF MORE THAN
25 YEARS
SUCCESSFUL
COMMINUTOR
EXPERIENCE



Model "A-1" BARMINUTOR . . . for use in rectangular channel sections 4 to 8 feet wide . . . sized for flows of 10MGD and upwords.



Model "C" BARMINUTOR . . . for use in rectangular channel sections 1 to 3 feet wide . . . sized for flows of .09 to 15MGD.

THE NEW MODEL "C" BARMINUTOR®

- Counter-weighted to minimize friction . . . increasing life of machine
- Stainless Steel Screen
- Ball Bearing Shoes
- Single Motor Drive . . . lower operating horsepower required
- Reversible cutting provides increased cutting capacity and extended life of cutters
- Rugged, economical design and construction



Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION

Chicago Pump Company

622F DIVERSEY PARKWAY - CHICAGO 14, ILLINOIS





Best Bid purchase of No. 14 Motor Grader pays off in round-the-year value

When you put a 150 HP Cat No. 14 Motor Grader to work, you know you have a machine with the size and power to get a job done fast, allowing you to use it for other roadbuilding assignments.

Plattsburg, New York, needed such a productive machine in winter for removing snow from its 75 miles of township and village roads and, during the warm

months, for repair, maintenance and building other roads. Township authorities decided that a machine the size of the No. 14 answered the year-round need for equipment with much higher productive ability than their older, smaller horsepower Cat Grader which had given nine years of superb service.

Purchased on the "Best Bid" basis, the No. 14 was \$5600 above the low bid. But the fact the trade-in value of the older Cat Grader was high and considering the quality manufacture, low operating costs, maintenance and depreciation of the No. 14, Plattsburg officials knew that the Caterpillar machine would cost them less in the long run.



Township Supervisor Bernard Amell believes in Best Bid buying of heavy equipment. As he says, "Public funds must have protection but price-tag protection breaks down and becomes self-defeating when applied to modern construction equipment. The exclusive consideration of initial cost of a complicated piece of machinery that must be used, serviced, main-

tained and repaired for several years results in miscarriage of legal safeguards. The accepted machine cost figure must include not only initial price, but also more important items such as fuel and oil consumption, ease in servicing, maintenance costs."

If you don't need a machine of the size and capacity of the No. 14, your Caterpillar Dealer can show three other motor graders: the 85 HP No. 112E, the 100 HP No. 112F, and the 115 HP No. 12E. Ask him for other cost records that prove Cat Graders give you lowest total cost.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

BUDGET STRETCHING FEATURES OF THE NO. 14

- Weight and stability: a hefty 28,520 lb.; 14.00-24 tubeless tires give superior traction.
- Easier service: exclusive Caterpillar Oil Clutch gives up to 2000 hours' service without adjustment. Dry-type air cleaner removes 99.8% of dirt from intake air.
- Versatility: with attachments like snow plow and snow wing, scarifier, ripper, or bulldozer blade (shown above).

CATERPILLAR

TO GET MORE
JOBS DONE FASTERTHE NO. 14

PUBLIC WORKS

THE MOST USEFUL ENGINEERING MAGAZINE FOR CITIES, COUNTIES AND STATES

APRIL, 1961 . Volume 92, Number 4

| \$35 Million Worth of Water System Deadlines—and More to Come Expansion of the city limits of Phoenix, Ariz., has created unusual problems for the water department in requiring 7,000 additional services per | 85 | Part of a county-wide water system using the west branch of the Niagara River as a source. Planned Maintenance Knows No Off Season | 118 |
|---|-----|--|-----|
| year. ART F. VONDRICK Maintenance of State Highway Shoulders | | a necessity for modern highways. E. D. REILLY The Migration of Fly Larvae from Refuse Containers | |
| Well-established blading routines, periodic replace- ment of aggregate and stabilization of problem areas keep Wisconsin highway shoulders in excel- lent condition. C. E. ATEN | | vs. Frequency of Collection | 120 |
| Aeration Tank Hazards Reduced by Safety Cable Safety belts attached to steel cables protect plant personnel. H. W. AUGENSTEIN BASIC PRINCIPLES OF PAVEMENT DESIGN: | 91 | Ductile Iron for Highway Construction | 122 |
| | | Small Size Pipe for Sanitary Sewers Minimum size and conditions of use is subject of study by Building Research Advisory Board. | 123 |
| Part II—Rigid Pavements | 92 | Toledo Water Supply Data | 124 |
| Factors affecting the performance of rigid pave- ments and design concepts currently in use by | | Street Lights Beautify a River | 130 |
| engineers are discussed in detail. E. J. Yoden | | Heater-Planers Get Bigger | 136 |
| What You Should Know About Managing Sewage Treatment Works A review of the managerial qualities required by men who direct the operation of large treatment plants. C. E. KEEPER | 104 | Traffic Sign and Marking Main enance for a Small City Substantial savings are made possible by use of a sign facing applicator. FRANK FORCE | |
| Iurbidity Removal with Coarse Grained Filters Laboratory investigations and pilot plant study indicate that gravel filters will produce a low tur- | 107 | Nuclear Energized Self-Luminous Signs for Highways | 142 |
| | | New Smog Warning Service | 152 |
| bidity effluent. L. E. HEIPLE | | 108-Inch Corrugated Me'al Pipe for Bypass | 156 |
| Municipal Experience with Compact Cars | 109 | The Standard Highway Pattern for Cities Presenting a goal for all planning and design viewpoints. ROBERT J. DAIUTE | |
| How Long Will it Take to Complete the Sewer? | 110 | PUBLIC WORKS DIGESTS: | |
| ckage Plan's for Sewage Treatment A discussion of the current trend in use of package plants at the sub-municipal level. | 111 | Highways and Airports | |
| | | Water Works | 144 |
| Photography Aids Municipal Functions Getting it down in black and white (or color) is easy with a camera, and it yields many benefits for Burlington, N.C. | 114 | Sewerage and Refuse | 156 |
| | | Industrial Wastes | 166 |

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DEPARTMENTS AND SECTIONS

| The Editor's Page 7 | APWA News Bulletins 125 |
|---------------------------|-------------------------|
| Leader in Public Works 18 | Films in Brief154 |
| Books in Brief 20 | News of Engineers172 |
| Reviews of Catalogs 34 | Municipal Power174 |
| Legal Notes 60 | New Equipment184 |
| Ed Cleary Says 72 | Worth Seeing191 |
| Engineering Notes 76 | Worth Telling192 |

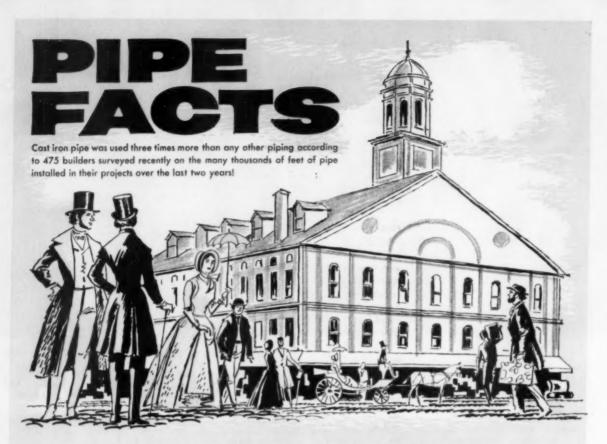
ESSEARCH DESEARCH

Established 1896
Public Works T. M. Reg. U.S. Pet. Off.

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PUBLIC WORKS JOURNAL CORP. 280 So. Broad St., Ridgewood, N. J.



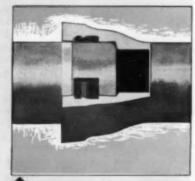
DO YOU KNOW that President Kennedy's greatgrandfather landed in Boston in the late 1840's ... about the time that Boston's first cast iron water mains were installed? That same cast iron pipeinstalled in 1847-is still in service. It is not surprising that more than 100 years later, cast iron pipe continues to be used extensively in Boston's water distribution system.



DO YOU KNOW that camels can go as long as two months without drinking water? For the rest of us, water is a daily necessity... residents of St. Louis, for example, consume 226 million gallons of water on peak days, or 156,944 gallons per minute!

DO YOU KNOW that service taps in cast iron pipe are far stronger than those in composition pipe? Direct force on the corporation cock installed in 6" Class 150 AMERICAN cast iron pipe resulted in breaking the service cock at 1,640 pounds. The corporation cock was torn from the wall of a similar class and size composition pipe at 940 pounds. And the pipe wall failed!





DO YOU KNOW that the AMERICAN Fastite Joint requires only a single joint component ... a superior, double-sealing gasket ... for each 18 or 20-foot length of pipe? Each joint on a 13-foot length of composition pipe requires two gaskets... a double joint with consequent double liability.



AMERICAN CAST IRON PIPE COMPANY
BIRMINGHAM
ALABAMA



Thoughts While Thawing

AS WE LOOK out our window at the slowly-thawing remains of a 22-inch snowfall, thoughts of a more moderate climate stir more than a little envy in our mind. From a practical viewpoint, however, we must admit, that the "borderline" areas of the country are often faced with more perplexing problems in planning for snow and ice control than are those northern regions where winter weather is virtually assured. The borderline organizations cannot make all-out committments of material, manpower and equipment to snow and ice control each winter season. Yet they must be prepared to cope with snowfall when it occurs. In fact, with drivers and vehicles less prepared for snowy weather, the need for expeditious clearing of streets and highways is accentuated if transportation is not to become crippled.

There is no ready solution to this problem about to be offered here. There are, however, a few basic rules of winter program planning that we can heartily endorse for any maintenance organization. First of all, it would seem that snowfall must be planned for in much the same fashion that rainfall is evaluated in drainage design. Storm intensities and frequencies over the years must be studied and evaluated. Secondly, equipment selection must be made with high priority given to its versatility and adaptability in a variety of assignments that will assure its year-around utility. Finally, sound plans must be developed and kept up to date to assure a successful and organized battle with the elements no matter how infrequently they attack.

County Government Has Great Opportunities

COUNTIES, SOME critics say, have failed to meet the problems that have arisen from modern trends in population. Some counties have lost population; others have gained population in embarrassing numbers. A shrinking tax base has handicapped the losing group—roughly one-half of our counties; a tremendous population growth has placed an equally difficult burden on many of the gaining counties, requiring heavy expenditures for such problems as transportation, water, sewerage and education.

There are defects in our county system. In the past the formation of districts to handle water, sewerage, fire, school and other needs was tried. Now many of these are unable to meet expanding needs in the gaining counties; and in the losing counties conditions are no better.

Great opportunities and responsibilities for leadership reside in the counties. They are logical units to assume broad responsibility in water supply; waste disposal; transportation; refuse collection and disposal; the attraction of industry; the growth of economic activity; rural redevelopment; and other areas of community services. But new outlooks, new viewpoints and more action are needed. It is past time for these to be developed.

Keeping Up to Date Can Make Money

N A WATER department report received recently were two statements which most folks will agree are interrelated. One said that some 4,000 water meters were now over 30 years old; naturally these meters do not register the full amount of water passing through them. The interrelated statistic is that unaccounted for water amounted to 18.0 percent in 1959 and 18.1 percent in 1960. The water department is aware of this problem but is handicapped by the fact that customers must purchase new meters. A sound business approach, with the municipality assuming financial responsibility for meters; the use of plenty of new meters; and proper maintenance of those already in use can be profitable to any city.

Urban Rehabilitation and Public Works

N A STUDY made during the past year by the Editors of Public Works, 319 cities reported a program of urban rehabilitation under way. In 270 of them, the program involved rehabilitation of existing structures. Of more interest, probably, to many of our readers, were the statements that 284 of the projects included new water lines; 291 required some new sewers; and 249 involved new lighting.

Thus urban rehabilitation provides an unusual opportunity for revising some of our essential utilities—water, sewers, lights and streets—many of which were installed years ago and have become overloaded or outmoded. Engineers should work closely with urban rehabilitation planners to be sure that the public works engineering phases are not overlooked. These, of course, involve many problems not limited to the few listed above, but nevertheless also requiring high engineering skills.



DON'T BE FOOLED BY INITIAL PIPE COSTS...

Certain factors concerning the type of pipe to be used for a proposed water or gas project must be examined carefully:

First

-how much does the pipe cost, compared to other types?

Second

-how often will it require repair?

Third

—how long before it has to be replaced? After all, how much money do you really save if you buy the cheapest pipe...then have to repair it frequently...and then have to replace it within a decade or two?

You save with cast iron pipe

Sometimes the first cost of jobs where cast iron pipe is specified, is higher than similar projects using cheaper pipe. Yet, in the long run, cast iron pipe costs less! Here's why:

- Cast iron pipe rarely requires repairs.
 Its rugged construction, corrosion-resistant qualities and bottle-tight rubber-ring joints will withstand the most severe presures.
 Once an investment is made in cast iron pipe, it is usually your first and last cost because of the absence of maintenance or repairs.
- Cast iron pipe is built to last—98 American cities will testify to that. They've had cast iron pipe installations in constant use for over a century! In fact, in Versailles, France, they're still using cast iron pipe water mains that were laid in 1664! Once cast iron pipe is in the ground, it stays there!

Don't be fooled by "low-cost" pipe. Insist on the pipe that will actually save you money over a period of years...

In Nebraska—Here a section of cast iron pipe is being relocated. Twenty-five years old, the pipe is still in excellent condition—has never required major repair . . . or replacement.

Rely on CAST IRON PIPE



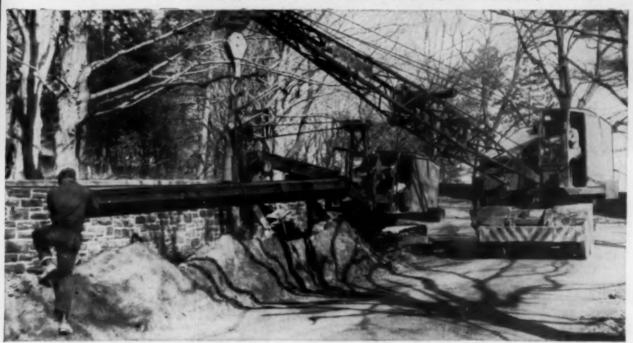
In Indiana (above)—"All-weather" cast iron pipe is quickly installed despite wet trench conditions. Slip-on joints were easily assembled, with one workman using a crowbar.



In Kansas (above)—36° cast iron water main. Another part of this main was floated out of its trench by a heavy downpour. Later a 150 psi water test revealed no leaks in the slip-on joints!

In Pennsylvania (below)—This 16° cast iron pipe is being installed as fast as the trench hoe can prepare the trench.

Handy lengths and slip-on joints make cast iron pipe easy to handle, even in crowded neighborhood sectors; require less labor.



CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE
Cast Iron Pipe Research Association.
Thos. F. Wolfe, Managing Director, 3449 Prudential Plaza, Chicago 1, Illinois



"pitched" for Alcoa Signs at the Whitehall Borough Council meeting one night last winter.

"He should work for Alcoa!" remarked one member after hearing-and agreeing with-Charlie's argument.

"Aluminum signs will cost us a lot less," said another councilman. "Our tax dollars will certainly go a lot further, just from the savings in maintenance costs!"

"Our vandalism problem has been greatly reduced," asserted Borough Captain of Police, John Wilson. "These Alcoa Signs can really take it! The safety factor of the luminescent, reflective surface shouldn't be overlooked, either."

"Competitively priced with other sign bids and other materials," concluded Charles A. Schmidt. "I am confident we can substantially reduce sign maintenance costs by starting an aluminum

"You should work for Alcoa and sell these signs," chides Whitehall Burgess A. J. Munn (left), as Borough Secretary Charles Schmidt demonstrates Alcoa Sign sturdiness to Police Captain John Wilson.





street and stop sign replacement program."
"Unanimous agreement!" intoned the council.

P.S.—This is a true story. Although the quotations may not be verbatim, the facts and the meanings are true. In less than two years, Whitehall Borough—a suburban community of Pittsburgh, Pa.—will complete its sign replacement program. Every stop sign and every street sign in the borough that has become defaced, rusted, worn out or illegible will be replaced with a sign

made of Alcoa® Aluminum. We couldn't make the sales presentation ourselves, but we think Charlie Schmidt did a fine job in our stead.

Call your nearest Alcoa sales office and learn how your community can stretch tax dollars with Alcoa Aluminum Street and Stop Signs and at the same time qualify for the big FREE Alcoa "Welcome to Your Town" sign. Or write: Aluminum Company of America, 897-D Alcoa Building, Pittsburgh 19, Pa.



BEHIND THE MAN FROM DIAMOND CRYSTAL SALT... the snow & ice removal experience of Blake Jordan!



Blake Jordan, Manager, Rock Salt Sales—Highway Division, Diamond Crystal Salt Company, is a fine example of home office assistance given the "Man from Diamond Crystal". On-the-spot experience and the understanding of problems by home office officials, helps Diamond Crystal salesmen serve your needs more efficiently.

Pictured above is Blake, supervising the unloading of Rock Salt for snow and ice removal onto a new storage depot at Buffalo, New York. In addition to the Buffalo depot, Diamond Crystal Salt Company has opened other strategically located Rock Salt Storage Depots throughout the snow and ice belt. These new depots can help you maintain maximum safety precautions by supplying all your salt for snow and ice removal . . . fast and economically.

Here are the locations:

Buffalo, New York Charleston, West Va. Chicago, Illinois Cincinnati, Ohio Cleveland, Ohio Detroit, Michigan East Liverpool, Ohio Green Bay, Wisconsin Holland, Michigan Louisville, Kentucky Marietta. Ohio Milwaukee, Wisconsin Port Huron, Michigan

St. Clair, Michigan
*Minneapolis, Minn.

*Prairie du Chien, Wis.

*Davenport, Iowa

Davenport, Iowa

*La Salle, Illinois *Michigan City, Indiana

*St. Louis, Missouri

Omaha, Nebraska

*Cargill Incorporated Distributors

Learn exactly what these new storage depots can mean to you for fast, economical service. Call or write the nearest Diamond Crystal sales office.



Diamond Crystal Salt Company

75th Anniversary 1886-1961

PLANTS: AKRON, OHIO: JEFFERSON ISLAND, LA.; ST. CLAIR, MICH.
SALES OFFICES: AKRON - ATLANTA - BOSTON - CHARLOTTE - CHICAGO
DETROIT - LOUISVILLE - MINNEAPOLIS - NEW ORLEANS - NEW YORK

Needham, Mass., Installs FIRST Plastic Sewer Main in U.S.A.





Evanite Plastic Pipe is guaranteed for 50 years





streets.

45° CURVE



install and handle. Write for additional information.

plastic drain and sewer pipe fittings.*

Evanite comes in standard 10-foot lengths . . . longer lengths available . . . up to 15 inches in diameter. Because of its lightness (2.5 lbs. per foot in 8-inch diam.), it is easy to carry, easy to

ther machining or working.



Evanite

stops infiltration

and exfiltration,

has a root-proof

says Sewer Superintendent

E. A. Symonds, Needham Superintendent of Sewers, selected Evanite Plastic Sewer Main in 8-inch diameters, plus plastic fittings and 4-inch plastic house connections, after extensive tests established Evanite as impervious to attack by chemicals found in sewage and industrial wastes. It was also determined that Evanite's nonabsorptive quality, as compared with existing sewer pipe materials, eliminates percolation through the walls, and has adequate crushing strength for sewer main service under city

Ease of installation also was a factor ... Evanite can be cut with a saw and rejoined without fur-

Six months after installation, the Evanite system was checked for deformation and leakage. It was found to be free from infiltration, completely straight and round. Mr. Symonds concluded, "In our opinion, the solvent welded joint used with Evanite Plastic Sewer Pipe is the most fool-proof joint on the market today. Evanite Plastic Main has demonstrated in service all the advantages claimed for it, and we expect to use it again on future projects in the Town of Needham." Evanite conforms to F.H.A. specifications for

joint,"

DIVISION OF THE EVANS PIPE COMPANY

LEESBURG, FLORIDA TELEPHONE: ST 7-1321 CARROLLTON, OHIO TELEPHONE: 68 One of the nation's largest producers of face brick, clay pipe, clay flue lining, wall coping, and related construction materials ... with over 50 years of faster, friendlier service.

DO IT RIGHT WITH EVANITE SEWER, GAS, WATER, IRRIGATION PIPE PUBLIC WORKS for April, 1961

EVA-160-119A

how Daly City solved sand problems

NEW SAND SEPARATOR ELIMINATES:

- clogged meters
- customer complaints
- booster pump wear
- · settled sand in pipes

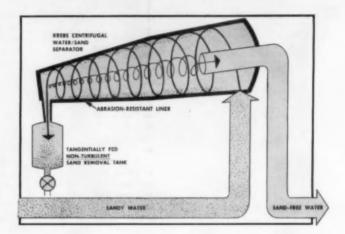
After installing a Krebs centrifugal water/sand separator*, the Daly City, California, municipal water system found immediate benefits in increased revenues and reduced maintenance costs. Their Krebs separator removes 97.8% of the total solids from the well water, and essentially all of the objectionable sand. The unit's efficient separating action results from optimum use of centrifugal force through the cyclonic principle as applied in the exclusive Krebs separator design. Krebs cyclones are accepted as the standard throughout the world in the field of dynamic classification.

Krebs separators are available custom-sized for any municipal well water system. They have no moving parts, require no maintenance, and utilize special sand-resistant liners which will last many years. Installation is simple, and needs a minimum of floor area and headroom. Integral mounting supports are provided; no special platform or framework is required.

*Patent applied for



This compact installation of a Krebs centrifugal water/sand separator, in Daly City, California, replaced two conventional sand traps, and provided substantially increased removal of fine sands.



Write today for descriptive bulletin. Specific recommendations for your own system are available without obligation.



EQUIPMENT ENGINEERS · INC.

737 LOMA VERDE AVENUE . PALO ALTO . CALIFORNIA

NOW...the all-new **BANTAM Compact 250**



and manpower needs.

Here is a compact machine that gives you all the benefits of cable and hydraulic operation-to speed up trenching, loading, handling, cleanout and hundreds of other vital public service jobs. Works with a full range of fast-change attachments for greater job range. Entirely BANTAM-built, including new, rugged 4 x 4 carrier. Or mounts on your own 4 x 4 or 4 x 2 truck.

Put this new compact-sized, compact-priced machine of wider work range in your plans now. Mail coupon.

This is the BANTAM Compact 250:

- Fully flexible truck crane-excavator-high speed mobility plus wider work range.
- Lifts five tons . . . digs 100' of 5' trench per hour!
- More versatile-unlimited job range with full convertibility: back hoe (cable or hydraulic-actuated bucket) . . . crane . . . dragline . clamshell . . . shovel . . . etc.
- Ultra-simplicity-single-shaft machinery . . . cable-controlled digging-lifting operations . . . smooth, hydraulic 370° swing; foolproof mechanical controls.
- Faster: swing, raise boom, work attachments-all at same time with BANTAM's independent action and fastest line speeds.

Heavy-duty BANTAM 350 series-Most popular crane-excavators in their class. Widely used by public bodies everywhere for heavy-duty 11-ton performance-preferred because of rapid travel. wide work range and low-cost maintenance. Work with 11 BANTAMbuilt attachments. Wide choice of BANTAM-built carriers. Also crawler and self-propelled models.



| Please send me complete literature and details on: | PW-317 |
|--|------------------|
| ☐ BANTAM Compact 250. | |
| ☐ BANTAM 350 as ☐ Carrier Model, ☐ Crawler | . Self-Propelled |
| Name | |
| Title | |
| Address | |
| City Zone State | |





Positive Ejection Saves Time . . . and Maintenance

You eject loads in seconds with a Mark II — return to collection routes minutes faster than ordinary dumping methods permit.

As the picture illustrates, tailgate raises out of way (hydraulically lifted through conveniently located controls).

Then a double-acting hydraulic cylinder actuates an ejection panel which bulldozes loads from body swiftly, safely, completely. No destructive shaking and jerking to loosen compressed material — means less maintenance of entire unit.

Also, positive ejection means you can match a Mark II body with a truck chosen on the basis of load-bearing capacity alone. No need to consider front-end weights to hold wheels on the ground while dumping.

Get full details on the more efficient Mark II from your Heil distributor. Capacities: 13, 16 and 20 cu. yd. "Duo-Press" Compaction Increases Payload... Cuts Operating Costs



Entire load is uniformly compacted between packer and ejection plates — from first to final loads. Increases payloads up to 15 percent or more...cuts operating costs.

Some Other MARK II Advantages:

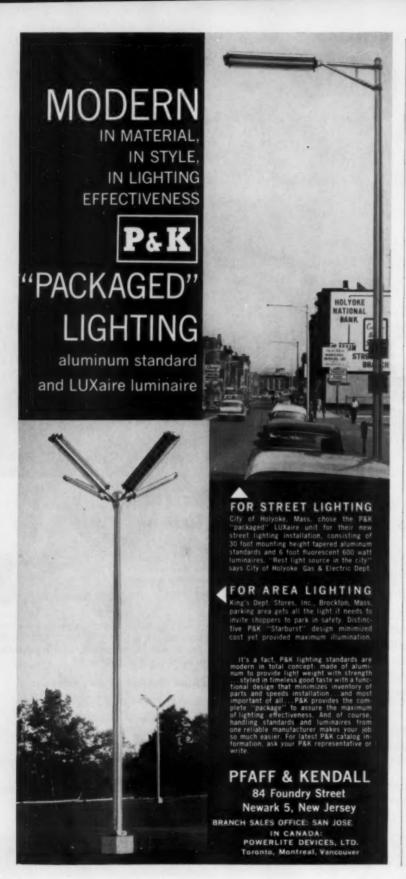
- Electronic push-button control of packing cycle.
- · Safe, fast loading with no jamming.
- Low, wide hopper sill (80 in.) makes loading easy.
 Hopper capacity, 1½ cu yd.
- Refuse collection containers picked up without close "spotting."
- Low clearance height even on 20-cu-yd model, it's less than 7 feet.

THE HEIL CO.

MILWAUKEE 1, WISCONSIN

COLECTOMATIC REFUSE BODIES

Factories: Milwaukee, Wis. • Hillside, N. J. • Lancaster, Pa. Cleveland, Ohlo • Modesto, Calif.





Albert B. Kaltenbach, as Director of Public Works for Baltimore County, is concerned with one of the Nation's fastest developing suburban areas. Urbanizing Baltimore County has been made necessary by a 225 percent increase in population in 20 years. The Department of Public Works, which has jurisdiction outside Baltimore City, provides construction. operation and maintenance of sewerage systems, streets and highways, street lighting, storm drainage, refuse collection and public buildings. Expenditures for capital projects in 1961 will total more than \$17.4 million: the Department of Public Works has an operating budget of \$16.5 million.

Mr. Kaltenbach was appointed to the directorship in 1959. He holds degrees from New Mexico State College (B.S. in Civil Engineering) and The Johns Hopkins University (Master of Sanitary Engineering). After working with Whitman, Requardt and Associates, the Baltimore Metropolitan District and the Baltimore Bureau of Sewers, he organized the County's first sanitary disposal and collection system, as Sanitation Engineer from 1948 to 1950. He joined the Department of Public Works in 1950 and served first as Assistant Director and then as Deputy Director until his present appointment.

His affiliations include the ASCE, of which he is a Fellow; APWA; AWWA; WPCF; National Association of County Officials; and various local organizations. He is also a Diplomate of the American Academy of Sanitary Engineers and a Director of the County Division, ARBA.

Mr. and Mrs. Kaltenbach have two girls and a boy. As hobbies he enjoys reading, book collecting and travel.

FOR A SOUND, SURE ODOR CONTROL PROGRAM

SEWAGE DISPOSAL PLANT

MAN HOLES

SARIFAXX DXX+85

Sanfax DX-85 combats objectionable odors at the source. The Sanfax Float Valve Assembly, attached to a 55 gallon drum, permits accurate, measurable material dispensing to insure maximum effectiveness without waste... and without troublesome attention and regulation.

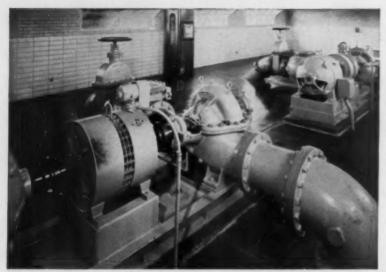
SOUND ODOR CONTROL CREATES

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E-M Ampli-Speed Drives provide Odessa, Texas Municipal Sewage Plant with adjustable pumping rate of 1 to 5.4 MGD. Pumps are held to $\pm 2\%$ of manually selected speeds.

Make two pumps do the work of three!

Here's how Odessa, Texas did just that with adjustable speed E-M Ampli-Speed Drives

PROBLEM: Odessa, Texas wanted to increase sewage facilities to treat sewage effluent as a source of industrial water for chemical and rubber plants.

OBJECTIVE: They needed a new, efficient sewage pumping station at minimum cost, with provision for future capacity.

SOLUTION: Odessa officials called in Parkhill, Smith & Cooper, consulting engineers of Lubbock, Texas. P. S. & C. suggested two alternatives: 1. Build a plant with three pumps, including one for peaking and standby; or 2. Install two pumps with E-M Ampli-Speed Drives.

Parkhill, Smith & Cooper favored the 2-pump plan for these reasons:

Minimum Capital Investment. The three-pump plan would tie up a considerable amount of capital in an extra pump, motor and control without adding appreciably to the volume of sewage pumped.

100% Peak Standby Capacity. Two pumps with E-M Ampli-Speeds could handle present demand efficiently, yet still have enough reserve capacity for 100% peak standby.

Low Cost Expansion. Later another pump could be added to double the station capacity and still allow 100% peak standby. And as a further saving, the building would not have to be enlarged to accommodate this third pump.

RESULT: Odessa took the advice of its consulting engineers and is now enjoying efficient, low cost pumping

As your pumping requirements grow, you too will want the economy and versatility that E-M Ampli-Speed Drives give you. Write the factory today for descriptive Ampli-Speed Bulletin No. 243, and call your nearby E-M Sales Engineer for details.



MEG. COMPANY

MINNEAPOLIS 13, MINNESOTA

Specialists in making drives do EXACTLY WHAT YOU WANT THEM TO



COMMENTARY ON WATER and SEWAGE TREATMENT

This is a reprint of the excellent series of articles, by the late R. S. Rankin, which appeared in Public Works Magazine during the period from September, 1958, to early in 1960. These articles covered, in a most practical way, such subjects as: Replacing conventional grit chambers; sludge removal from primary clarifiers: sedimentation tank efficiency; trickling filter research; sludge thickening; measuring digester performance; sludge digester capacities: elutriation: home grinding of garbage; package plants; recreational use of reservoirs; water quality; turbidity removal; diatomite filters for water supply; and the need for filter rate controllers. There are 76 pages, 31/4 x 71/2 inches. Sent on request to C. M. Comstock, Dorr-Oliver, Inc., Stamford, Conn.

WATER SUPPLY AND WASTE TREATMENT

In recognition of the modern necessity of considering effective waste treatment correlative with water supply in connection with water resources, a single text has taken the place of works handling the subjects separately. Water Supply and Purification and Sewerage and Sewage Treatment, both by W. A. Hardenbergh, have been combined in essence with complete rewriting in more concise form and updating. Col. Hardenbergh is joined by Edward B. Rodie as a coauthor in the new book. The result is 471 pages covering the field from rainfall to treatment plant design. Wherever it was feasible, water and wastes are discussed jointly in a chapter; i.e., Chapter 1: The Water-Sewage Cycle; Chapter 3: Water Use and Sewage Volume; and Chapter 4: Hydraulics of Water and Sewage Conduits. Unit processes are described; water and sewage treatment evaluation criteria explained: and design data for treatment plants given. A chapter is devoted to the procedure employed by a consulting engineer in



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Loader is a compact, fast-handling unit well suited to general building work. Five forward speeds and power steering insure easy handling, full maneuverability. Turning radius is only 8 feet 8 inches.

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BACKHOES

AND

EARTHMOVING

EQUIPMENT

working with a city from preparing preliminary report to advertising for bids, including typical methods of estimating revenue to cover bond retirement and operation costs. The appendix includes a tabulation of symbols used for graphic representation of distribution system appurtenances, the Public Health Service Drinking Water Standards, and check lists for design of water and sewage treatment plants. The book contains many examples of typical computations, and each chapter is followed by a list of problems. Illustrations, mostly line drawings and functional, total 200.

The publisher is the International Textbook Co., Scranton 15, Pa., and the price is \$11.00. Copies may be obtained from that firm or from Public Works.

SELECTING AIRFIELD PAVEMENT TYPES

This is a very complete 134-page booklet prepared from the viewpoint of the bituminous pavement industry. Chapter headings include structural adequacy; operational characteristics, including fuel spillage, smoothness and skid resistance; safety; and cost. There is an excellent bibliography and three appendices. Copy on request from National Bituminous Concrete Association, 1145 19th St., N.W., Washington 6. D. C.

STEEL **SPECIFICATIONS**

Two new standard steel specifications have been issued. One covers both specifications and loading tables for open web steel joists, long span or L-series. The other covers architecturally exposed structural steel. Free on request from American Institute of Steel Construction, 101 Park Ave., New York 17, N. Y.

SOIL COMPACTION AND PROOF-ROLLING SUBGRADES

Four papers in this 36-page bulletin (No. 254) cover: Full Scale Compaction Studies at the British Road Research Laboratory; Proof-Rolling of Subgrades; Hydraulic Fill Compaction; and Rapid Determination of Liquid Limit by Flow Index Method, \$1 from Highway Research Board, 2101 Constitution Ave., N.W., Washington, D. C.

MOBILE HOME PARK SANITATION

This is a revision of "Trailer Court Sanitation" and provides a comprehensive sanitation guide for owners, manufacturers, health departments and local authorities, A suggested ordinance for control is included in the text. Individual copies from The Public Health Service, Washington 25, D.C.

LANDSLIDES AND **FOUNDATIONS**

Three papers on this subject cover: Methodology of Landslide Investigations in Soviet Russia; Soil and Foundation Investigations on the Patapsco Tunnel; and Mathematical Expressions for the Circular Arc Method of Stability Analysis. Bulletin 236; 68 pages; \$1.20. Highway Research Board, 2101 Constitution Ave., N.W., Washington, D. C.

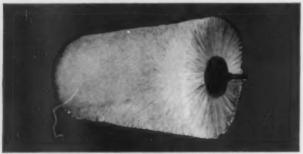
WATER & SEWAGE REPORT FROM ALLIANCE, OHIO

The sixteenth annual report of the Department of Water & Sewage of Alliance, Ohio, is complete, detailed and interesting, with plenty of data, both tabular and other. There are 92 mimeographed pages, loose-leaf bound, with charts and diagrams providing a history of the plants and records of operation. Donald D. Heffelfinger is Engineer-Superintendent.

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A. B. Cole, Director of Public Works, Lexington, North Carolina

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all power boosted for easy operation. Dual brakes give operator choice of braking with or without transmission engagement.

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Ah hates bein' watched

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Fact! Whenever ... wherever Tyton Joint® pipe goes into the ground it wins more than its share of attention.

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General Office: Birmingham 2, Alabama

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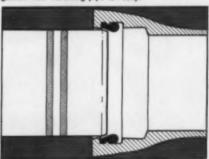




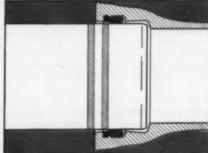
Insert gasket with groove over bead in gasket seat . . . a simple hand operation.



Wipe film of Tyton Joint® lubricant over inside of gasket. Your receiving pipe is ready.



Insert plain end of entering pipe until it touches gasket. Note two painted stripes on end.



Push entering pipe until the first painted stripe disappears and the second stripe is approximately flush with bell face. The joint is sealed ... bottle-tight, permanently! The job's done fast, efficiently, economically. Could anything be simpler?

How a 4-in-1 can be the "WHOLE WORKS" FOR YOUR PUBLIC WORKS DEPARTMENT!

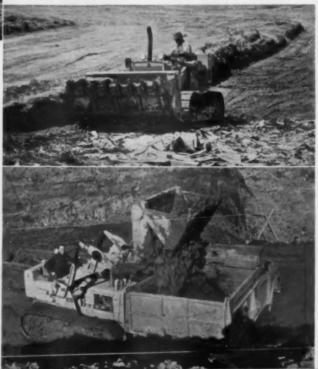




Give it power-shovel jobs! Note the ease with which this 3 cu. yd. TD-20 Four-in-One digs up old concrete pavement applying 43,150 lbs. of break-out force. All 5 sizes of International Drott 4-in-1's have famous pry-overshoe break-out—to take over tough excavating work that formerly required far costlier boom-type rigs!

Benefit from sanitary landfill efficiency no obsolete or limited-duty bucket can deliver. Only the clam-action 4-in-1 provides clam "biting" action, and controlled dozing, to spread refuse evenly. Only the 4-in-1 gives "carry-type scraper" action to cover refuse uniformly on the go—then irons down and seals the cover with compactor plate! "We discovered no competitive equipment that would approach the 4-in-1 method of waste disposal," report the commissioners of Gunyersville, Alabama—the city that owns the TD-9 shown here!

Load 'most anything, anywhere—including sticky materials other buckets can't handle—and on muddy, sandy, rough, or hilly footing which only sure-treading tracks can negotiate! Note that the clam-action 4-in-1 gives exclusive bottom-dumping that ends sticky materials problems. Opening the clam pulls materials from bucket surfaces—gravity down-pull does the rest—for positive self-cleanout dumping!

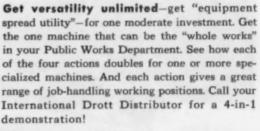




Let it "double for a doxer" as Colonial Heights, Virginia, does! Here, their TD-9 Four-in-One gives full-size, full-capacity doxing performance filling in an old pond area—to add an acre of more useful land to the city! "Our 4-in-1 cuts the need for several pieces of equipment down to one basic machine," reports Supt. of Streets E. S. Jones!

Do "carry-type scraper" and "grader" work—and get inchclose grading accuracy with the
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for maintenance and new construction.

Produce surfacing materials at new low cost with clam-action 4-in-1 versatility and big capacity. Note how this TD-15 Four-in-One operator "back-drags" select sub-base material down from the bank by the truck-load—for fast, easy loading! Clam-action 4-in-1's do the work of several types of machines in pit or quarry!



Five sizes: 3/4, 11/8, 11/2, 21/4 and 3 cu. yd.



International Harvester Company, Chicago 1, Illinois Drott Manufacturing Corp., Milwaukee 15, Wisconsin



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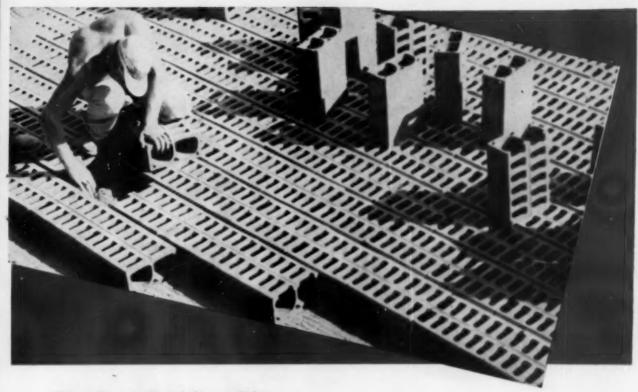




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The best Trickling Filters

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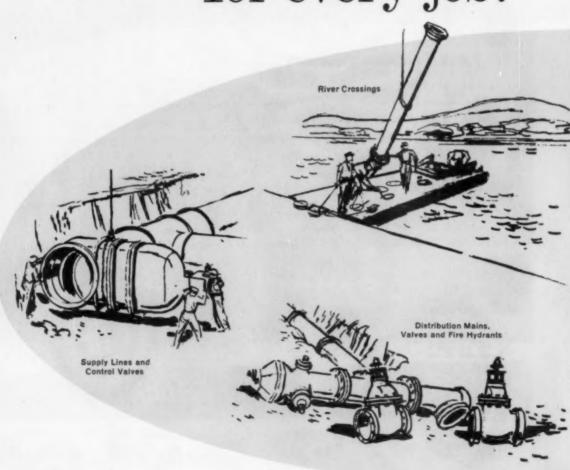
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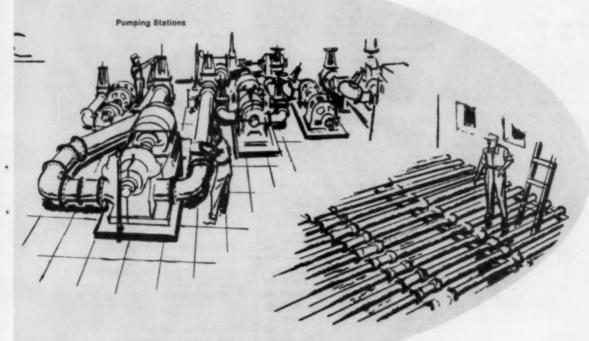
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Snow & Icepage 42
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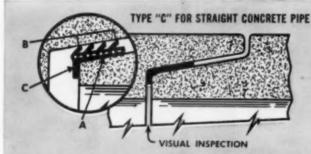
"C" SERIES flexible GASKETS



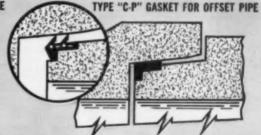
Sanitary Engineers can take advantage of the matchless efficiency of TYLOX Flexible Gaskets for coupling any concrete pipe sewer they design ... because there's a specially designed TYLOX cross-section for any type of concrete pipe!

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TYLOX "C" Series Gaskets are made for all pipe sizes, handle head pressures up to 50-feet, and are available in either rubber or neoprene. They may be applied to pipe at the pipe manufacturer's plant, or at the job site. Like all TYLOX Gaskets, they are immune to sewerage and industrial waste acids, and keep joints water-tight for the life of the pipe itself.



TYPE "C" Gasket under full compression



TYPE "C-P" Gasket under full compression

"C" Series TYLOX Gaskets consist of base A; sealing fins B; and inspection flange C. In addition to providing the inspection feature, the "locking" effect of the flange holds Gasket in true position as pipe is coupled. Design of the sealing fins is such that horizontal endthrust forces causing "kickback" in some couplings, are eliminated in Tylox "C" Series Gaskets, assuring full seating and true alignment of pipe.



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NEW LISTINGS (Cont.)

A New Tapping Machine

644. . . with ten special features is described in detail in 8-page brochure that water utility superintendents will find useful and interesting. For your copy, write for Bulletin T-54 to The A. P. Smith Mfg. Co., 545 No. Arlington Ave., East Orange, N. J., or check off our card-number.

A "New Look" in Magnetic Drive Water Meters

648. Easy-to-read features of the first magnetic drive meter with a disc meter chamber are illustrated and emphasized in Bulletin DER-961, available from Badger Meter Mfg. Co., 4545. W. Brown Deer Road, Milwaukee 23, Wisc. Check the inquiry card.

Controllers-Pneumatic and Electric

649. A 56-page illustrated catalog covers new modular design features as well as the new proportional plus rate control units, partial chailtistings and contact control forms. Ask for it as Specification C-15-2n from Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa., or check our card-number.

How to Select and Apply Floodlights

635. Is the title of a 16-page detailed illustrated discussion of just what those planning outdoor floodlighting want most to know. Tells how to calculate light levels, gives recommended footcandle levels and photometric data for General Electric floodlights equipped with filament and mercury lamps. Ask for it by name from General Electric Co., Schenectady 5, N. Y., or check our card-number.

How to Fix Pipe Splits or Breaks Without Shut-downs

460. Here is a new way—repair clamps that are lighter, easier to install by only one man at greater speed and low in cost. & Pagge folder gives the whole story, pictorially and with specifications. Get Form 330-B from Adams Pipe Repair Products, South El Monte, Calif., or use our card.

Use The Reply Card

Pre-Engineered Metal Buildings

664. This new illustrated catalog of 16 pages tells how you can save time and money and gain in beauty and utility by use of ready-to-erect buildings. For Catalog No. BD-660 write Buildings Div., Parkersburg Rig & Reel Co., Parkersburg, W. Va., or circle the card-number.

Make Your Citizens Happier by Controlling Irritating Odors

645. Whether these come from treatment plants, incinerators, dumps, sewer manholes or lift stations improve your public relations through effective combating of odors. Descriptive literature telling how to do it can be had from Sanfax Corp., P. O. Box 604, Atlanta, Ga., or by using our reply card.

Valuable Information on **Factory-built Package Plants**

666. Oxy-Pak factory-built package plants are described in Bulletin 417 which tells how the plants work, give design criteria, list sizes of units available and show the components of a typical plant. Write American Well Works, 100 No. Broadway, Aurora, Ill., or check this paragraph number on the return card.

Manual on Highway Railings For Bridges and Roadways

678. This manual covers design suggestions, components, specifications for design and construction and the advantages of Alexa aluminum alloy highway railings. Check the reply card or write Aluminum Company of America, Alexa Bidg., Pittsburgh 19, Pa., for this valuable manual.

Low Cost Erosion Control Treatment also Speeds Seed Germination

679. New super-highways call for new products and methods. You will welcome the information on Vulcanol spray muleh described in this new folder of Alco Oil & Chemical Corp., Trenton Ave. and William St., Philadelphia 34, Pa. Circle our card-number.

Get the Sand out of Your Meters and Pumps

650. There is a way to do this, the new Krebs centrifugal water/sand separator. How it does this is the subject of helpful literature to be had direct from Equipment Engineers, Inc., 737 Loma Verde Ave., Palo Alto, Calif., or by checking our card-number.

Better Blowers for

Sewage Treatment Plants

485. Engineered to reduce maintenance and replacement costs. Seven design features incorporated to give you better results. Write for detailed specifications to Sutorbilt Corp., Dept. F, 2966 E. Victoria St., Compton, Calif., or use the reply card.

Custom Engineered Refuse Trucks

lecting trucks lead a hard life. It is better if they are engineered for it. Information on the "Reo C-Series" can be had by addressing Reo Motor Truck Div., 1331 S. Washington St., Lansing 10, Mich., or by using our reply card.

This Weed Killer Works Wonders

447. Even kills weeds underground before they start as well as after they appear. The full description of how and why this killer R-50 works so well is given in technical data Report No. 49. Address Zep Mfg. Corp., 1310 Seaboard Industrial Blvd., Atlanta, Ga., or use our reply card.

STREET LIGHTING AND TRAFFIC CONTROL

Finest Line of Markers for Fine Line Marking

165. Complete information on truck mounted highway markers, self-propelled line markers, all purpose line markers, and hand-propelled line markers is available from the M-B Corporation, New Holstein, Wis. Photographs and specifications of each type of line marker are included. For more, check the handy reply card.

Complete Catalog on **Traffic Control Equipment**

240. All types of controllers, PR system of coordinated traffic control, vehicle detectors, timers, vehicle conterts and radar speed meters are covered in catalog available from Automatic Signal Div., Eastern Industries Inc., Norwalk, Conn. Check the reply card.

Manual on All

Types of Traffic Signs

379. This 26-page manual covers regulatory, warning, school, railroad, street name, road construction, route markers, miscellaneous signs and plastic reflectors. Check the reoly card or write The Miro-Flex Co., Inc., 1824 East Second St., Wichita 14, Kans.

Cut Crime and Accidents Complete Bulletin

396. . . with better street and highway lighting. Good design means good lighting standards, arms, bases and luminaires. A catalog, ALS-5, is just out containing working engineering specification data, over 20 drawings and complete and detailed data on various Pfaff and Kendall lighting standards, including luminaire specifications. The entire catalog is cross indexed. Address Pfaff & Kendall, 84 Foundry Street, Newark, N. J.

Lighting Standard Equipment

Tot. Included in these two catalogs, Octagonal Tapered Steel and Aluminum (No. 0-1-860) and Aluminum Round Tapered (R-1-10-60), are new designs in both street and area lighting standard equipment with a good variety of arms to meet most any lighting problem. Traffic Signal Standards and Brackets and Mast Arms for wood, metal pole and wall mounting are included in the Round Aluminum catalog. Write to Kerrigan Iron Works Company, Eleventh & Herman Street, Nashville 2, Tenn., or circle reply card.

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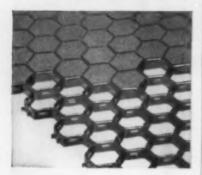
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WATER WORKS

Handbook of Cast Iron Pipes and Fittings

52. Full engineering data on products of the Alabama Pipe Co., including Super De-Lavaud cast iron pressure pipe and pipe fittings, valve boxes and other municipal castings are orovided in Pressure Pipe Catalog No. 54, a 196-page publication of Alabama Pipe Co. Anniston, Ala. Weights, dimensions and specifications are clearly indicated in this easy to use in reference.

How to Select Right Angle Drives

62. Data-filled Catalog 31 of Johnson Gear & Mfg. Co., Ltd., 8th & Parker Sts., Berkeley 10, Calif., makes it easy to select the correct right-angle gear drive for deep well turbine and other vertical shaft pumps. Includes details on the Johnson "Redi-Torq" gear drive. To get your copy just cheek the reply card.

Convenient Reference Manual Covers Cast Iron Pipe, Valves and Hydrants

76. An 80-page manual, issued by R. D. Wood Co. Independence Sq., Philadelphia 5. Pa., presents specifications for "Sand-Soun" sat iron pipe and fittings, outlines types of joints available, lists dimensions and weights in sonvenism tables and includes, in addition, full magineering data on the Mathews and R. D. Wood fire hydrant and R. D. Wood gate ralves.

Rapid Sand and Pressure Filter Data

109. Rapid sand filters. A complete line of vertical and horizontal pressure filters, wooden eravity filters, and filter tables and other equipment. For engineering data, write Roberts Filter Manufacturing Co., 640 Columbia Ave.. Darby, Pa., or check the reply card.

Information on Service, Valve. Roadway and Meter Boxes

122. Literature on specifications covering Buffalo" service, valve. roadway and meter coxes, and adjustable valve boxes for water and ras has just been released from Buffalo Pipe Foundry Corp. Box 55-Station B, Buffalo 7, V.Y. Check the realy card for your information on these valve boxes.

The Submersible Pump You have Been Waiting For

141. Electric, fully submersible, portable, runs dry without damage, no priming, and other outstanding advantages. All are described in Flygt Bulletin B-80L of Flygt Corp., Hoosick Falls, N. Y. Address them or just circle the number on our card.

A Comprehensive Handbook on Water Meter Settings

174. "The Engineering of Water Meter Settings" contains 34 pages of clearly illustrated data and specifications to help improve your practices and simplify your work. Every Water Department should have a copy of this valuable reference book. To get yours address Ford Meter Box Co., Inc., Wabash, Indiana, or use the inquiry card.

Design of Prestressed Concrete Tanks

194. An 8-page technical Bulletin, T-19, on the Design of Prestressed Conerete Tanks, gives engineering data and formulas of general interest to anyone considering prestessed concrete for storage tanks. Check the reply card or Write to The Preload Co., Inc., 355 Lexington Ave., New York 1, N. Y.

Manual on

Filter Bed Agitators

206. General information-specifications and installation data regarding the application of Palmer agitators, or rotary surface wash in vertical and horizontal pressure filters—round, square and rectangular open gravity type filters are covered in Manual from Palmer Filter Equipment Co., 822 East 8th St., P. O. Box 1696, Erie, Penna. Check the reply card.

Complete Catalog and Reference Data an Valves and Fittings

211. The entire M & H line of valves, fittings and accessories for water works, filtration, sewage disconal and fire projection are dilustrated and fully detailed in Catalog 52 issued by M & H Valve & Fittings Co., Annistron, Als. In addition to complete data on these products, there are many pages devoted to kelpful ensuseering data Every designer should have a cosy.

To Meet Increasing Water Demands, These Two Steps Will Help

These Two Steps Will Help
247. Two new products designed to help
meet constantly increasing demands for water
are described in a folder of Hersey-Sparling
Meter Co., 250 Eim St., Deham, Mass. These
are a flow analyzer that provides strip chart
rate of flow and volume records, and a two-rate
register that can be substituted for the flow
analyzer. Get this data by checking reply card.

Cut Down Your

Underground Explorations

276. . . for buried pipe by knowing where it is before you start digging for it. "Typical Pipe Detection Problems and Their Solution" is the title of a free 24-page illustrated, pocket-size book that tells you how to find and determine the depth of buried pipes, conduits, wires and cables. Address Computer-Measurements Co., 12970 Bradley Ave., Sylmar, Calif.. or check above number on our card.

Clow Bell-Tite Cast Iren Pipe

280. Laying water mains is easier, faster and more economical with Clow Bell-Tite joint cast iron pipe. Joint employs a single rubber gastet as the only accessory. Complete details available in illustrated literature from James B. Clow & Sons, Inc., P. O. Box 6600-A. Chicago 80, Ill., or check the reply card.

Water, People and Hydrodynamics

302. is the title of an illuminating booklet dealing with the world-wide problem of how to get water in adequate supply. when and where needed. Your copy can be had for the asking of Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill.

Offering a Handbook on Steel Pipe

309. This 40-page "Handbook of Tubular Products" contains dimensions, weights, test pressures, and specifications for Bethlehem continuous butt-weld and electric resistance-weld steel pipe. Standard and tentative specifications for welded and seamless steel pipe are also included, Address Bethlehem Steel Co., Bethlehem, Pa., or let us get it for you by circlina card-number above.

Centrifugal and Turbine Type **Pumps For Water and Sewage Plants**

321. Turbine-type pumps, close or flexible couple drive, and end suction centrifugal pumps are described in Catalog M available from Aurora Pump Div., The New York Air Brake Co., 636 Loucks St., Aurora, Ill. Included is a pump selection guide and spigot pipe.

How to Control Algae

371. Details on the control of various microscopic organisms frequently found in water supplies are furnished in a 44-page bookled offered by Phelos Dodge Refining Co., 300 Park Ave., New York 22, N. Y. Check the reply card.

Water Works Couplings, Clamps and Sleeves

426. Fully described in useful 24-page booklet covering all your pipe needs. Ask for "Water Works Catalog" of Dresser Mfg. Div., Bradford, Pa., or just circle the number on this card.

American Ductile Iron for

Pipe, Tubing, Casing and Fittings

463. A 36-page illustrated catalog that describes the complete line of American Ductile iron Pipe Co., P. O. Box 2603, Birnsingham 2, Ala. Check the reply card for technical data including grades, specifications, dimensions and weights, uses and applications.



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Three lightweight, compact units (1) true spotlight antenna (2) booksize chassis unit, and (3) easy reading indicator — all readily mounted from driver's seat without tools.

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One or two man operation depending upon manpower and type of traffic.

Meter is adaptable to all types of roadways. Three switch-selected ranges short, medium and long - to 500' on cars (more on trucks).

Meter provides clean, steady readings. Narrow beam - focuses on intended lane.

Antenna is operable in any weather. No prongs or protrusions. No rain cover needed.

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Write for Bulletin R-115

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Using Amizol alone, or in combination with other weed killers, state and local highway departments are instituting successful and complete vegetation control programs along thousands of miles of roadsides, guard rails, gravel shoulders, bridge abutments, center strips and embankments.

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Data on Adjustable-Speed Magnetic Drives for Low-Lift Pumps

445. A catalog is available from Electric Machinery Mfg. Co., Minneapolis 13, Minn. that tells all about E-M Vertical Synchronous Motors and Magnetic Drive Units. Engineers check the reply card for information on this equipment for sewage pumps.

Usiflex Boltless Flexible Joint Pipe

471. New 8-page booklet describes joint provided with Usiflex pipe. Simple, rugged bottle-tight joint for cast iron pipe which is assembled without use of bolts. Locked against pull-out and offered as ideal for underwater installations. Address U. S. Pipe and Foundry Co., 3300 First Ave., North, Birmingham 2, Ala., or check our card-number.

Helpful Information on Elevated Steel Tanks

485. Factors to be considered in the selection of elevated steel tanks plus capacities, dimensions and particulars of many attractive designs are provided in 20-page Bulletin 101 of Pittsburgh-Des Moines Steel Co., Neville Island, Pittsburgh 25, Pa. Use inquiry card to get your copy.

Vertical Turbine Pumps

508. . . with a history of low maintenance costs and practically no service calls. These data are offered you in the helpful literature to be had from The Deming Co., 293 Broadway, Salem, Ohio. Check number on inquiry card.

Water Meters with Choice of 7 Features

521. . . and geared to mineral and chemical characteristics of your water. Complete design flexibility built-in to meet varied needs the country over. Get all the facts with Bulletin 58 of Buffalo Meter Co., Dept. PW, 2917 Main St., Buffalo 14, N. Y., or check the card-number.

Handbook on How to Lav Concrete Pressure Pipe

524. Manual on concrete pipe laying instructions is available from Price Brothers Co., Dayton, Ohio. Check the reply card for information on how to dig the trench and handle the pipe, make the joint and the pipe bedding procedure.

Even Parshall Flumes Can Be Improved!

538. And now they are. Just how, with new polyester resin bond, is covered by this fact-sheet describing the new advantages of-fered you in sizes from 3-inch through 24-inch throat widths. Light weights for easy handling is an added feature. Write for Bulletin 80; to Simplex Valve & Meter Co., 7 E. Orange St., Lancaster, Pa., or circle number on card.

Floatless Liquid

543. Catalog describes the B/W system of liquid level control, liquid level relays, electroides, signals and alarms with descriptions, charts and diagrams of typical applications. Check the reply card or write B/W Controller Corp.. Birmingham, Mich.

For Easy Reference on Contractors' Pumps

598. . . . get the McGowan bulletin on a complete line suited to all municipal needs. Self-priming models in I-in. to 8-in. size, light weight and heavy duty, centrifugal and diaphragm types. Write McGowan Pump Division, Leyman Mfg. Corp., 10900 Kenwood Road, Cincinnati 42, Ohio.

Air Control Valves For All Types of Pipelines

429. Literature on Crispin Air Valves, which safely control air in lines handling liquids, to maintain efficient operation and prevent expensive failures, is available from Multiplex Manufacturing Company, Dept. C, Berwick, Pa. Write today for your copy of the Crispin Air Valve Catalog, which offers complete information on the full line of dependable Crispin Air Valves.



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Now you can have accurate grading and day-long comfort even on your toughest jobs.

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Healy-Ruff Company offers a complete line of easy-to-install, simple-touse pressure-sensing controls for water works and sewage fields. Control only, or indicating and recording as well, can be supplied. All systems incorporate these desirable features:



- Ball bearing rotation and springless mechanism—measures pressure to ½% of operating range
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THE R-4 ROTOTROL permits controlling high and low elevation of water in an elevated tank, stand pipe, or reservoir. Automatically compensates for pumping friction. Closed system and booster system controls also available. Bulletin R-4

THE PW ROTOTROL controls both pressure and water lever in hydropneumatic tanks. Cuts off pumps on either high pressure or high level Airadd or air-release types. *Bulletin PW-6*

THE RPS ROTOTROL controls level in pumping stations, sewage plants or reservoirs. Senses level change through corresponding change of pressure in compression bell submerged in wet well. Purged air or compression pipe types. *Bulletins RPS and RS3*

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Remote supervisory controls • Complete system controls • Elevated
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To Insert Valves Under Pressure . . .

555. . . . let your first step be review of this "step-by-step" folder on Mueller tapping and cutting-in sleeves and valves. Write Mueller Co. Decatur, Ill., for Form W-8899 or circle number on our card.

Waterspheres and Waterspheroids

563. Modern designs in elevated steel tanks—are described in 16-page brochure with photographs and tables of standard sizes. For your copy, write Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago 4, Ill., or circle the number on our reply card.

In Tapping Machines Progress Never Ends

566. Now the B-100 double pressure chamber machine is available as described in new folder. Learn now what it can do for you by writing for Bulletin 8912 to Mueller Co., 512 W. Cerro Gordo, Decatur, Ill., or by circling our card-number.

Metering Pumps

580. Get the full treatment in twin brochures filled with valuable data to the water works head who is on the lookout for all that is new in good chemical feed pumps. For yours, address Wallace & Tiernan, Inc., Belleville 9, N. J., or check our card-number.

Play Safe with Automatic Controls

403. Remote engine and pumping controls of every sort are fully described in a series of bulletins offered by Synchro-Start Products Inc., 8151 N. Ridgeway Ave., Skokke, Ill. Write them or circle the above number on our card.

Electronic Locators for Water Mains, Services, Valves and Boxes

477. Miniaturized line locator that is encased in a molded glass fibre container and has transistors that have a rated life of 70,000 hours and weighs only four lbs. when completely assembled is described in literature from Wilkinson Products Co., 3067 Chevy Chase Drive. Pasadena 3, Calif. Check the reply card.

You are not Seeing Double

488. The Weil submersible sewage and sump pumps actually offer a choice of two motors, two controls. MICRO switch controls start and stop pumps, alternate pumps, and to provide high water alarm. Get Booklet SE-860 for complete engineering information from Weil Pump Co., 1526A N. Fremont St., Chicago 22, Ill., or circle card number

Bulletin Covers Step-by-Step Action on the Water Problem

689. A step-by-step outline of action telling bow the responsible citizens can help their officials extend and improve the local water system through more adequate rate structures on financing is covered in this bulletin available from Thos. F. Wolfe, Managing Director, Cast Iron Pipe Research Association, 3440 Pruden-

Water Filtration Costs Can Be Reduced

692. The "Celite" system of diatomite Stration makes possible reduced installation cost, with space requirements a fraction of those for equivalent sand filtration. For informative literature write Johns-Manville, Box 14, New York 16, N.Y.

SNOW AND ICE CONTROL

Snow Plaws For Every Need

294. Frink snow plows are designed to meet snow removal needs at airports, parking lots and streets and highways. They consist of four basic types with models to fit trucks 1½ to 12 tons. For complete data write Frink Sno-Plows, Inc., Clayton, N. Y.

EXTENSIVE TESTS ESTABLISH VALUES for MANNING's n

There has been considerable loose talk lately about "new" values for Manning's n when figuring flow coefficients for sewer lines. Manufacturers of one substitute material for lifetime Vitrified Clay Pipe say their pipe has a lower n factor, allowing flatter grades or smaller diameter pipe.

Independent tests show that this is not true.

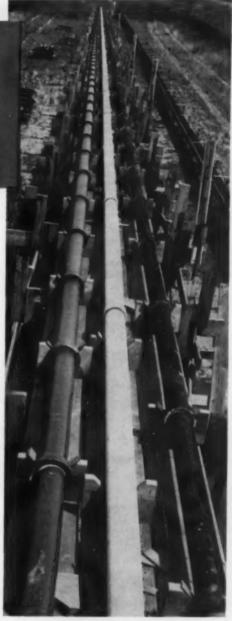
For example, the new "Design and Construction of Sanitary and Storm Sewers" manual contains a table entitled "Suggested Values of n for Manning's Formula." According to this table in the new standard for sanitary engineers, the range of values for n is exactly the same for lifetime Vitrified Clay Pipe and all normally used substitutes for this material.

Extensive tests just completed by independent researchers demonstrated this same point, as do other independent studies quoted at length in the manual.

Remember, there is no substitute for research. And there is no substitute for lifetime Vitrified Clay Pipe in your sewer lines.

*Prepared by a Joint Committee of the Water Pollution Control Federation and the American Society of Civil Engineers, 1960.





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Please send me full details on the new factory-made compression joints on Clay Pipe.

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The "City Slicker" cleans a wide path by means of air power and vacuum ... no brooms or brushes to wear out or service. It sucks up and separates for quick handling: (1) all kinds of light bulky litter: newspapers, paper cups and wrappings, cigarette butts, etc., (2) dry sand; (3) light fine dust.

With maximum operator visibility the "City Slicker" is Safe and maneuverable in heaviest traffic. Dusty air



is cleaned in special cleaners . . . no filter elements to clean or service and no need for water sprinkling. Using a "City Slicker" releases large power sweeping equipment for more important dirt sweeping work for which they are dseigned.

"City Slickers" are now performing money-saving litter collection work in several large cities. For details see your TARCO dealer or write to us.

TARRANT MFG. CO.

28 Jumel Place, Saratoga Springs, N. Y.

EBMI Underground Boring Machine New! Improved!



Model 70

- BORES-with no surface break
- BORES-up to 250 feet in length
- BORES-up o six inches diameter
- BORES-so drill stem of pipe of conduit stays
- BORES-1,000 feet on 1 Gal. of gas
- REAMS-up to 12 inches diameter Write immediately for information.

EARTHWORM BORING MACHINE, INC.

P. O. Box 1100 Santa Monica, California

EITHER BY THE GLASSFUL, OR THE BILLIONS OF GALLONS . . .

. . . pure water is the lifeline of Municipalities and Industry.

For over 60 years, Roberts Filter
Manufacturing Company has been
complementing the engineering profession in supplying water purification
equipment throughout the Western
Hemisphere.

ROBERTS FILTER

Manufacturing Company Darby, Pa.

REFUSE COLLECTION AND DISPOSAL

Load-Packer 600 Points the Way to the Best in Refuse Collection

188. Bulletins W-200, W-220 and W-221 explain how the Gar Wood Load-Packer gives faster operation, bigger payload, more compaction, a larger hopper and more dependable operation. Write Gar Wood Industries, Inc., Wayne, Mich., or check the reply card.

How to Construct

A Sanitary Fill

331. A new 12-sage booklet which tells the most efficient method of samitary fill construction and furnishes complete information on elamning and operation is now available from Drott Mfg. Cors., Milwaukee 15, Wis. Get your copy by checking the ren'v card: vou'll find this booklet both interesting and valuable.

Prompt Service on Sweeper Refill Fibers

367. Here's a dependable source of power sweener refill fibers, including domestic and imported types and gutter broom wire. To get all the data write A. Steiert & Son, Inc., Hatfield, Pa., or use our reply card.

Pushbutton Refuse Collection

449. Pushbutton control of the packing cycle is just one of the many features of the Mark II Collectomatic refuse collection unit. In addition the unit offers fast, safe loading: "Duo-Press" compaction; positive ejection without raising body; simplified maintenance. 13, 16 and 20 yd. capacities. For all details get Bulletin IH-60106 from The Heil Co., Milwaukee 1, Wisc. Use the inquiry card.

Progress in Refuse Removal

495. . . registers a new high mark with the Hobbs Hyd-Pak 60 model. Gives lower loading height, watertight body, 3 "extra" yards all in one ultra-modern, proven piece of equipment. For details on this unit and a pick-up container system, address the Hobbs Hyd-Pak Division, 609 N. Main St., Fort Worth, Texas.

New Dempster Book

507. . . . tells the full, illustrated story of what Dempster Brothers offer in the way of wastes collection, containerization and disposal equipment. 28 pages in color. Get your copy from Dempster Bros. Knoxville, Tenn., or circle our reply card.

Data on the Hydro E-Z Pack Refuse Collection

572. This disposal body has no movine chains, no whirling knives, and has a 76,600 lb. pressure that takes anything and compacts everything. Check the reply card or write Hydro E-Z Pack, Div. of Hercuies Galion Products. Inc., Galion, Ohio, for a copy of Bulletin EZ-100.

Refuse Incincrators for Every Need

714. including supermarkets, schools, hospitals, restaurants and municipalities may be selected from Bulletin No. 185 of Morse Boulger, Inc., Dept. 160, 80 Fifth Ave., New York 11, N. Y. A feature of the bulletin is a tabulation of basic weight calculation factors for determining the capacity of an incinerator for a given installation. Check the reply card.

RECREATION

Heavy Duty Swimming Pool Equipment for Municipal Pools

193. Illustrated bulletin showing heavilbuilt diving and deck equipment is available from American Playground Device Co., Ander son, Ind. Check the reply card for specifications on diving boards, data on diving stands towers, slides, pool ladders and pool cleaning

sewers or culverts... Hopto cuts costs

Hopto Model 200 SPR all-hydraulic backhoe is a versatile, one-man machine with easy job-to-job mobility. There's no tail swing — Hopto can work in close quarters where other excavators can't be used. Your Warner & Swasey dealer can show you why Hopto is your best investment . . . ask him to arrange a demonstration.



World's largest line of hydraulic construction and excavating equipment.

To order these helpful booklets check the reply card opposite page 34.

PACKAGE PLANTS FOR SEWAGE TREATMENT

Turnkey Sewage Treatment Plant

239. Plants for smaller population areas that are furnished and installed on a turnkey basis are covered in literature from Municipal Service Company, 4625 Roanoke Parkway, Kansas City 12, Missouri. Check the reply card for your key to low cost sewage treatment.

Factory-Built Sawage Treatment Plants

313. If you plan one, plan first to get this latest booldet on them. Tables, data charts and specifications are compactly given in its 14 pages. Ask for Catalog 504, from Public Works Div., Schmieg Industries Inc., P. O. Box 4701, Detroit 34, Mich. Or circle this card.number.

Rated Aeration Now Can Be Had in a Package

112. Chicago Pump's aerobic digestion sewage treatment plant is available as a factory assembled unit combining comminution, diffused-air aeration and settling for 1,000, 3,000, and 5,000 gpd loads. Write for bulletin on Rated Aeration SS. Chicago Pump, Pood Machinery and Chemical Corp., 622 Diversey Parkway, Chicago 14, Ill., or check the reply card.

Package Sewage Plants for 50-5000 Population

181. Design information on Walker "Sparjair" package sewage treatment plants for sizes from 50 to 5000 population equivalent is presented in a 12-page bulletin, No. 19-S-94. Typical plans and sections, special design considerations, specifications and a discussion of the "how" and "why" of the contact stabilization process are included. Check the inquiry card or write Walker Process Equipment, Inc., 840 No. Russell, Aurora, III.

Package Plant Provides Big-City Sewage Treatment

41. With a design based on the "Ten State Standards." the Bio-Pac employs two-stage bio-filters, primary and secondary settling and sludge digestion, all in a single corrosion protected steel shell. Design criteria for selecting appropriate sizes for residential, industrial plant, restaurant, motel and trailer court and school use are featured in Folder 2971. Also given are dimensions and installation data for 50 to 500 population equivalent plants. Write to Link-Belt Co., Colmar, Penn.

Packaged Sewage Treatment For Very Small Installations

407. Domestic sewage treatment for small developments, restaurants, schools, motels and other installations having flows up to 15,000 gpd can be handled in the single-tank CompleTreator. Compact, easily installed and simple to operate. Complete data in Bulletin 2315 of Dorr-Oliver, Inc., 77 Havemeyer Lane, Stamford, Conn. Use the inquiry card.

Complete Data for Complete Treatment

667. Eimco-Process Aerobic Digestion plants for treatment of organic waste waters for resument of sloops of the complete treatment of 3,000 to 300,000 gpd of sanitary or organic waste. Write for Bulletin PW-1010. The Eimco Corporation, P. O. Box 300, Salt Lake City 10. Utah, or use our handy inquiry reply card.

For Prompt Service Use The Reply Card

Full Data on Aerobic Digestion Plants

668. Aerobic Digestion plants for 1,000 gpd to 20,000 gpd are described; plant capacities, dimensions and weights are listed; and data furnished on blowers, motors, pumps and installation features. Write Fabricated Equipment Corp., Lorain, Ohio, or check this paragraph number on the return card.

Assemble Your Small Treatment Plants from Prefabricated Components

479. Complete trickling filter, activated sludge, Imhoff tank or septic tank sewage or industrial waste treatment plants can now be assembled from prefabricated concrete block components. The Schreiber compact unitized plant can be built in capacities suitable for 120 to 15,000 persons. Get details from American Schreiber Co., P. O. Box 482, York, Pa., or check reply card.

Factory-built Sewage Treatment Plants to Serve Smaller Users

673. Complete factory-built Oxigest sewage treatment plants for small subdivisions, schools, motels and factories are described in detail in an illustrated brochure furnished by Smith & Loveless, Div. of Union Tank Car Co., Lenena, Kansas.

Sewage Plants for Small Communities

674. "Total Oxidation" type sewage plants give economical BOD removal, and serve communities of 75 to 3,000 people. The Accelomation of the service of the s

Aeration Tanks in Series for Commercial Buildings

675. An aerobic digestion type sewage treatment plant sized to the requirements of small commercial establishments has been added to the Yeomans line, to fill the need for a plant between the Cavitette and the Cavitator. Twin mechanical aerators are installed in a two-compartment aeration tank. Waste flow through the plant is through a trash tank to the aerators and on to a settling tank fitted with a sludge return mechanism. Application-selection data available on request from Yeomans Brothers Co., 2000-1 North Ruby St., Melrose Park, Ill.



TRACK-MOUNTED MODEL

for accuracy and operation ease

Track-mounted power model has one-man operation; drills laterally up to 14" hole at rate of 5' per minute; drills long range, 200' or more; powered by Briggs & Stratton engine; accurate, portable; Hydrodynamic dirt flush action.

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"MODERN" Earth Auger—either track-mounted or hand-held model, drills under shrubbery, lawns, walks, terraces, streets, railroads, highways without damage to property or disrupting traffic. Water pressure flushes out dirt loosened by the auger; return auger bits will enlarge hole to desired size on return drilling.



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for Economical Drilling

Hydrodynamic dirt flush; first job pays for itself, 4" and up dia. return augers; extension shafts 5' length, 34" dia. available; use any length pipe.

Complete with 2" pilot auger with ½" or ¾" drive shank.

Contact your wholesaler or write:

Modern Products, Inc.
P.O. Box 344, Dept. PW, Exeter, Nebraska



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THE THRIFTY NEW CASE. 750 PUTS MORE PROFIT IN YOUR POCKET

Here's a medium-price, 1%-yd tractor-shovel that opens up entirely new profit opportunities — despite increasing competition. It's the all-new Case Model 750 — featuring power-boosting torque converter and exclusive, proven Terramatic® transmission that eliminates clutching, shifting and stalling.

With its 72 hp* Case-built diesel, the "750" loader develops 11,200 lbs breakout... lifts 5300-lb loads to a height of 10 feet... travels up to 6.6 mph. It also provides exceptional maneuverability for fast work in tight spots. Power-shift and effortless power-steer make the "750" so easy to operate that even a novice can produce like an "old pro" in just a few hours. Result, the Case 750 handles both large and small jobs faster and more economically than any rig in its price class.

And that's not all! You'll find it's the easiest of all tractors to service and maintain . . . right on the job . . . with simple hand tools.

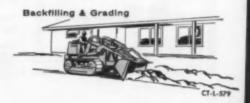
The "750" is also available as a power-angling dozer or powertilting dozer. Matching equipment includes hydraulic winch, ripper, pallet fork, and block fork. So, if you have been feeling the cost-profit squeeze, see this money-making new crawler soon at your Case Industrial Dealer's. Or write direct to J. I. Case Co., Dept. D1341, Racine, Wis., for details.













SPECIFY SUTORBILT **3200 SERIES BLOWERS** FOR SEWAGE TREATMENT PLANTS

Rugged Sutorbilt rotary positive-pressure blowers reduce maintenance, cut replacement costs, and assure a high level of performance. They deliver 800 to 23,000 cfm at pressures from 2 to 12 psig. Available with timing gear diameters from 10" through 26" in horizontal designs. Many sizes also offered in vertical case arrangements. Ideal for aeration of grit chambers, channel aeration, pre-aeration flotation, flocculation, tank aeration, air lifts, gas recircula-

Design Features

TWO-PIECE, impeller case strongly ribbed to prevent distortion

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OVERSIZED ROLLER BEARINGS, in cartridges for easy removal

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CLOSE-GRAIN CAST IRON IM-PELLERS, precision bored to receive shaft

MACHINED SUB-BASES as standard equipment

LUBRICATION by force-feed pressure system

Write for detailed specifications on the versatile Sutorbilt Blowers. Dept. F.

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STREETS AND HIGHWAYS

Chip Dollars from Your Overhead With Fitchburg Chippers

160. Detailed cutaway drawings, specifications, diagrams. charts and money-saving reports and experiences are covered in catalog available from Fitchburg Engineering Corp. Dept. PW, Fitchburg, Mass.

Useful Attachments for "Payloader" Tractor Shovels

95. Increased versatility for Hough "Payloader" tractor shovels is made possible by the various attachments described in literature of the Frank G. Hough Co., 761 Seventh St., Libertyville, Ill. Illustrated and described are rotary "V" and trip-blade snow plows, hydraulic backhoe, back-filler blade. pickup sweeper, scarifier teeth, winches, etc.

To Sweep a Better Street for Less

162. Find out about what Prostran can do to make your street sweeper brooms last longer. cut "down-time" and lower your cost per sweeping mile. A folder, with sample polypropylene filament is yours for the asking from E. B. & A. C. Whiting Co., Burlington, Vermont.

How Are Your Bridge Floors?

185. If you face replacements—or plan new bridges—you will find much really helpful data on steel mesh bridge flooring, safety features, tractional surfaces, dimensions, weights, loads and spans in a new booklet offered by Irving Subway Grating Co., Inc., 50-90 27th St., Long Island City 1, N. V. Includes detail drawings, specifications, also data on bridge sidewalks. Write for "Irvico Decking" booklet today

Heavy Jobs or Light Jobs-Ford Tractors Will Fit

Pord Tractors Will Fit

203. The versatility of Ford tractors and
equipment for construction is given new
emphasis by the handsome new four-color,
16-page booklet that shows Ford loaders, backhoes, dozers and grading equipment in use with
Ford tractors. Heavy and light loading and
excavating for a variety of municipal jobs are
specially featured. Get Booklet AD-8250 from
Tractor and Implement Div., Ford Motor Co.,
2500 E. Maple Road, Birmingham, Mich., by
checking the inquiry card.

Reinforced Concrete Cribbing for Highways and Embankments

267. Typical wall sections and details of standard units of open or closed face concrete cribbing are covered in catalog from American. Marietta Co., Concrete Products Div., American-Marietta Bidg., 101 East Ontario St., Chicago 11, Ill. Check the reply card for general specifications and installation of the cribbing.

Don't Dig-Auger

328. Modern earth augers and their applications in installations under lawns, streets, highways, walks, buildings, etc. are discussed in this bulletin, Al-10M-2-60. Write to Modern Products, Inc., Exeter, Nebraska.

Soil Sampling is a New and **Necessary Art**

374. Latest developments in it are fully covered in this new booklet that belongs in your files, as news now and for quick reference always. Bulletin No. 300-1, Sprague & Henwood, Inc., Scranton 2, Pa., or circle our card-number.

1961 Truck Line Story From Chevrolet

446. The 1961 Chevrolet truck line is described fully in literature from Chevrolet Motor Division, General Motors Corp., General Motors Building, Detroit 2, Michigan. Check the reply card for data on this line of 165 models.

Versatile Trenchers Mount On Jeeps or Tractors

504. "Gear-Draulie" boom-type trenching attachments by Auburn mount on tractor or Jeep, give new utility to your equipment. Get descriptive brochures from Auburn Machine Works, Inc., Auburn, Nebraska. Use the inquiry card.



An ounce of prevention is a pound of chloride.

-Bob Sproule

'LL ALLOW that my figure of speech doesn't figure, except in a figura-tive sense . . . but the substance of it is really quite simple. Dust problems are easier to prevent than to cure . . . and a pound of calcium chloride provides the prevention. A pound per square yard, that is, on gravel roads that are nicely shaped up and still moist in the Spring.

My wife tells me the time is now, and I don't doubt for a minute that she's right. We live on a gravel road, and she's developed a keen sense of timing about this thing. When she says "chloride," I pass the word to our County Engineer . . . and, bless him, he goes straight to work. Haven't seen dust in these parts for years. Wonderful woman, my wife. Mind what she says.

P.S.: Don't forget that calcium chloride solution makes the best kind of ballast in tires of earth-movers and other off-the-road vehicles. It increases drawbar pull, reduces punctures, provides freeze-proof weight where it's needed-30% more weight than water. Complete instructions for using it are given in our folder, "Wyandotte Cal-cium Chloride for Year-Round Tire Ballast." Write: Wyandotte Chemicals Corporation, Dept. FS, Wyandotte, Michigan.

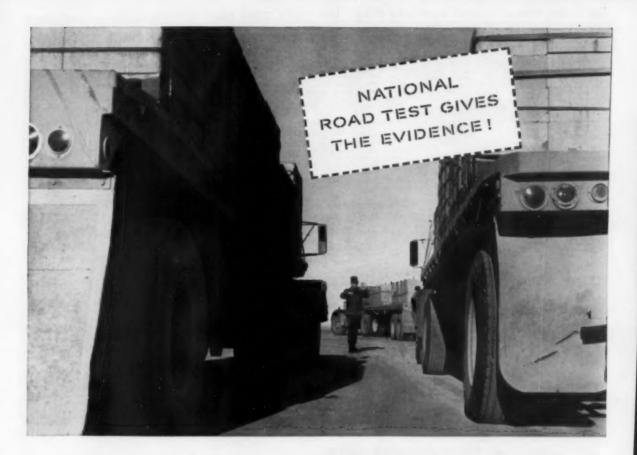
WYANDOTTE CHEMICALS



MICHIGAN ALKALI DIVISION

HEADQUARTERS FOR CALCIUM CHLORIDE

PUBLIC WORKS for April, 1961



Concrete wins over asphalt these basic ways...

Sponsored by The American Association of State Highway Officials (AASHO)... directed by the Highway Research Board of the National Academy of Sciences—National Research Council. Here is the most scientific pavement test ever made. Accurate instrumentation checked performance of test sections during 2 full years of traffic. 99 trucks, 19 hours daily, 6 days a week. There were 17 million miles of travel—1,113,762 load applications!



DURABILITY

A count of pavement sections surviving in the great National Road Test, after two full years of traffic, showed concrete outlasted asphalt 3 to 1! Here is new confirmation that concrete gives more for tax dollars.



DRIVING COMFORT

In ratings of how test pavements retained the riding quality they started with, concrete won over asphalt by a wide margin. Only concrete can give lasting driving comfort without excessive maintenance.

PORTLAND CEMENT ASSOCIATION

A national organization to improve and extend the uses of concrete

To order these helpful booklets check the reply card opposite page 34.

Plan Now for Your **Spring Mowing**

331. It won't be long before spring mowing problems will arise on highways, turnpikes and airports, as well as in parks, and on public golf courses, and institutional grounds of cities, counties and states. For a booklet with complete information on equipment available, and some helpful advice and data, write Jacobsen Mfg. Co., Racine, Wisc., direct, or by circling our card number here.

Information en Boring Machines

345. General operating instructions for the Earthworm boring machine, a portable consecution for underground installation of size and conduit are available in new bulletin just released by Earthworm Boring Machine, Inc., P. O. Box 1100, Santa Monica, Calif. Suggested procedures for installing pipe or conduit and a price list are included.

For Better Work All Over Town

\$25. Put a Bantam in your life. On trenching, excavating, street and highway work this handy versatile crane-excavator obviates using larger equipment in many cases. Sevetime and dollars. Get descriptive literature from Schield Bantam Co., 301 Park St., Waverly, Iowa or circle card-number.

Salt, Sand and Cinder Spreaders

532. . . . are fully discussed in folder No. A-450 outlining how these are dump body mounted for quick attachment and detachment according to service and season. Basic specifications outlined. Just subtress Baughman Mfg. Co., Jerseyville, Ill. or use the reply card.

Complete Line of **Asphalt Patching Mixers**

586. Mixers capable of mixing 3 to 20 tons of hot mix per hour are described in literature available from McConnaughy Mixers, Inc., Lafayette, Ind. Check the reply card for full information on patching, repairing, resurfacing and sealing.

The Trucks You Need for Every Public Works Job

461. Extra life and operating economics are built-in features of every Ford truck model. There's a chassis size and engine for each of your needs, from light utility work to heavy-duty construction jobs. Get latest literature from Ford Motor Co., Truck Div., Dearborn, Mich., by checking the reply card.

All-Weather Spreader for Standard Dump Trucks

472. Get data on the new "Rollgate" hydraulically driven roll-type spreader that applies uniform amounts of salt, and, cinders or other materials up to 1 inch diameter over an 8-ft. width. Write Good Roads Machinery Corp., Minerva, Ohio, or check the inquiry card.

Vacuum Cleaner and Leaf Collector For Cleaner Streets

595. A unit is now available that can be mounted on a right-hand drive jeep or a pick-up truck for picking up gutter trash and leaves. Complete specifications, capacity, operation and installation procedures are covered in a bulletin available from Tarrant Mfg. Co., Saratoga Springs, N. Y.

Variable Pitch Rotaries for all Mowing Requirements

401. The Roof VP Mower with blade pitch adjustment for different cutting conditions handles all mowing chores from dense weed removal to park lawns. Check this heavy-duty equipment for your turf maintenance needs. Data from Roof Mfg. Co., 1228 North Wallus St., Pontiac, Illinois, or check the reply card.

Transit Cranes for Bridge and Highway Building

691. Transit cranes that can lift 33,000 lbs. at 20-ft. radius, and 13,000 lbs. at 40-ft. radius with 60-ft. boom and outriggers set redescribed in literature from Bucyrus-Eric Co., South Milwauker, Winconsin, Also featured are load control, folding boom and boom lengths.

Design of Concrete Pavements For City Streets

437. Sections covered in this manual are classes of streets as to traffic, quality of correte, working stress and safety factor, types of pavement design, design procedure, joining of municipal pavements and use of distributed steel. Check the reply card or write Portland Cement Association, J3 West Grand Ave., Chicago 10, 111.

BUSINESS ADMINISTRATION

By Filming Your Records

57. Microfilm your records by using the Recordak Microfilmer. Check the reply card or write Recordak Corp., 415 Madison Ave., New York 17. N. Y., for operation, use and price of this machine. Also available is literature on the Recordak Verifax Copier that makes certified copies 15 times faster than typing.

Monthly Time and Cost Record Book

249. To assist owners in determining the cost of owning and operating equipment Caterial Paractor Co., News Service, Peoria, Ill., has prepared a 24-page monthly time and cost record book. Twelve sets of pages are included on which to record day by day machine expenses for an entire year. Check the reply card for your copy.

Stop Waste in Hand Washing

497. Quick cleanup after the job with a saving of soap and your employees' tims is easy with Gojer hand cleaner and dispensers. You'll find it pays you, too. Get details from Gojer, Inc., Box 991, Akron 9, Ohio. Check inquiry



TO YOUR

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MAKE and MODEL MOBILE 54" BROOM MOBILE 58" BROOM FILAMENT \$195.85 \$293.15 \$208.30 \$310.60 WAYNE 450, 460, 520 and 550 ELGIN STREET KING \$258.20 \$388.10 FIGIN WHITE WING \$258.20 \$388.10 ELGIN 20, 30, and 81 \$270.15 \$300.05 AUSTIN-WESTERN 40 \$208.15 \$303.55 AUSTIN-WESTERN 60 \$230.75 \$333.20

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Centrifugally cast APCO Cast Iron pipe is made to last 100 years or longer. It's cheaper by far in final costs than any nonferrous pipe your city can buy. With the fast assembly ALTITE® JOINT, it's easy, simple and inexpensive to install.

Available from adequate stocks in sizes 3" through 24" in modern long lengths, ALTITE, bell-and-spigot, and mechanical joint.

Write for your copy of Catalog No. 54

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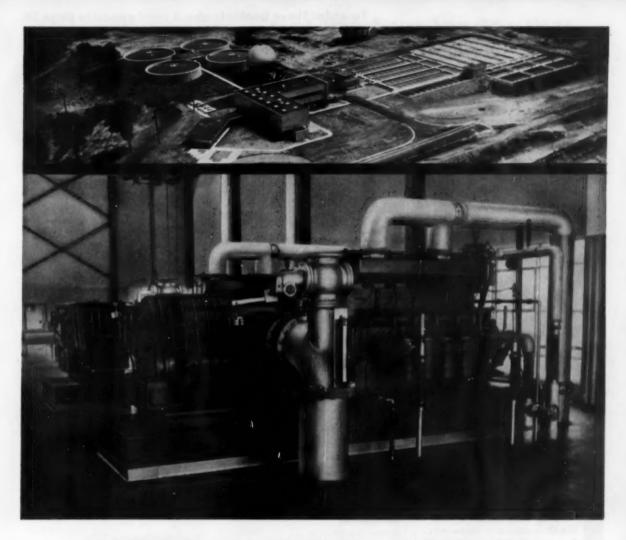
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APCO



WHITE/SUPERIOR ENGINES OPERATE ON FREE SEWAGE GAS

at Hamilton, Ohio's 12,000,000 gallon per day sewage treatment plant

Two White Superior 6G-825 gas engines at Hamilton, Ohio's new activated sludge type sewage treatment plant are saving taxpayers thousands of dollars yearly. Engines operate on free sewage gas produced in the plant digesters. The Superiors, each rated 300 bhp at 690 rpm, drive blowers with a total capacity of 14,000 cfm to aerate sewage. Heat from engine cooling water also helps heat the buildings.

Superiors also feature outstanding design simplicity, with fewer moving parts than comparable power units. Maintenance and repair costs are minimized, and re-

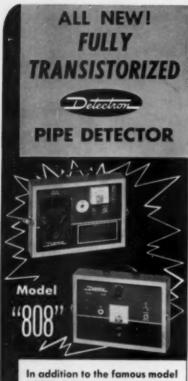
placement parts are seldom needed, even after extremely long periods of operation.

White Superior covers every municipal power requirement with a complete line of dependable diesel, dual-fuel and gas engines, 190 to 2150 hp, or 150 to 1500 kw. Write for literature today! WHITE DIESEL ENGINE DIVISION, Springfield, Ohio.





White Diesel



In addition to the famous model "505" Detectron now offers its completely new model "808" with the first circuitry developed specifically for use with transistors. It is NOT merely an adaptation of earlier tube circuits.

Efficient under every known operating condition, effective in varying temperatures, thoroughly proven and trustworthy. Superior performance and reliability guaranteed.

EXCLUSIVE FEATURES

- ▲ Detects Deeper by all comparisons
 ▲ Automatic Switching for direct
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- A Printed Circuits, properly shielded
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- Batteries
- A Built-In Battery Testers
- ▲ Snap-Lok Connecting Handle
- ▲ Aluminum Cases for maximum protection



SEWERAGE AND WASTE TREATMENT

Water and Sewage Plants

167. Engines are four-cycle, 6 or 8 cylinder, in-line models, ranging from 190 to 2150 bhp and from 135 to 1500 KW, are available either naturally aspirated or supercharged, and can be furnished to run as diesel, dual-fuel or gas engines. For Bulletin #115A check the reply card or write White Diesel Engine Div., The White Motor Co., Springfield, Ohio.

Rubber Joints for All Types of Concrete Pine

205. . . are described and their advantages outlined in a new Engineering Manual which engineers in particular, will find valuable with respect to physical properties and performance characteristics of rubber compounds used in such joints. Plenty of on-the-job illustrations of value to contractors and all pipe-layers. Address Hamilton Kent Mfg. Co., 427 W. Grant St., Kent, Ohio, or check our card-number.

Gravity Sewer Pipe Engineering Classifications

305. A quick method for choosing the most economical class of asbestos-cement sewer nipe to suit each laying condition with handy crushing table based on the Marston formula is available from Keashey & Mattison Co., Ambler. Penna. Check the reply card.

Tips for Installing Orangeburg Pipe

336. Good practice for installation of Orangeburg pipe and fittings is outlined in an illustrated four-page bulletin made available by the Orangeburg Mfg. Co., Div. of The Flintkote Co., 375 Park Avenue, New York 22, N. Y. Trenching and backfilling, pipe laying, cutting and connecting.

Engineering Data on Gas Safety Equipment

343. P.F.T. Gas Safety Equipment for Controlled Digestion is the subject of an excellent 12-page bulletin issued by Pacific Flush Tank Co., Chicago 13, Ill. Full engineering data on flame traps, pressure releases, waste gas burners and related equipment is provided in convenient form. Requests for this valuable booklet must be made on business letterhead.

Prefabricated Sewage Ejector

354. Komline-Sanderson has a new twocolor, four-page brochure on pneumatic sewage
ejector stations. Construction features; compressor motor horsepower selection chart; plan
and elevation drawings of station. Write Komline-Sanderson Engineering Corporation. Peapack, N. J., asking for Bulletin KSM-3, or
use the card.

Trenches for Water and Sewer Line Construction

384. Three Cleveland J trenchers incorporating major advances in trencher design and operating advantages are described in Bulletin L-104 available from The Cleveland Trencher Co., 20100 St. Clair Ave., Cleveland 17, Ohio. Check the reply card for digging capacities, specifications and dimensions.

Reinforced Plastic Pipe and Fittings

549. for water and sewage service, in sizes 2 through 8 inches, made of epoxy resins and glass, highly resistant to hydrogen sulfide gas, electrolysis and difficult soil conditions. Booklet tells all in 16 illustrated pages. For your copy write Americal Corporation, 4809 Firestone Blvd., South Gate, Calif., or circle number on the card.

Controls For Use in Pumping Stations and Sewage Plants

542. Single and multi-pump sump controls, pressure operated for use in pumping stations and sewage disposal plants are described in literature available from Healy-Ruff Co., Water Level Controls Div., 2255 University Ave., St. Paul 14, Minn. The two principal types of pressure operated sump controls are covered along with general descriptions and features.

Wedge-Lock "O" Ring Joints for Vitrified Clay Pipe

482. Joints for large diameter pipe, using the Wedge-Lock principle of factory made joints plus a rubber "O" ring for compression sealing, described in 4-page folder of Evans Pipe Co., Uhrichaville, Ohio. Check reply card for your copy.

Three New Sewer Rodding Machines

594. Just announced and worthy of your attention. Literature describing them and their new features will be a valuable guide for your sewer rodding operations. To eccure it address Flexible, Inc., 415 S. Zangs Blvd., Dallas, Texas; or circle our card-number.

Sludge Removers for Tanks of Any Size or Type

659. The Rex Unitube Tow-Bro Sludge Remover is described as a proven standard of the industry. Bulletin 315-81 shows how Tow Bro can be applied to tanks of any size or type. Write Chain Belt Co., Milwaukee 1, Wis.

CONSTRUCTION EQUIPMENT AND MATERIALS

Don't Stand There Figuring!

51. Use the new Forney PSI Calculator "slide rule" for concrete products that includes instant conversion data from total load to sei on 17 standard test specimens and masonry units. Pocket size. Free. Address Forney's Inc., Tester Div., Box 310, New Castle, Pa.

International Wagner Heavy-Duty Loaders and Backhoes

198. International Wagner loaders and backhoes are matched with International utility tractors and are described in Catalog CR.1369-K available from International Harvester Co., Consumer Relations Dept., 180 N. Michigan Ave., Chicago 1, Ill. Check the reply card.

A Fully Rotary Compressor by Jaeger

209. Complete information is available from The Jaeger Machine Co., Columbus 16, Ohio on this 2-stage, oil-cooled rotary compressor. Features include 80% fewer moving parts, up to 30% less weight, vibrationless operation and 100° cooler air.

Slurry-Seal Spreader For Surface Sealing

378. The new slurry-seal method with the Tarco spreader gives a thin, even application of asphalt-sand-water slurry and fills and scals cracks and makes skid-proof surfaces. Check the reply card or write Tarrant Mfg. Co., 28 Jumel Place, Saratoga Springs, N. Y., for complete details.

Bituminous Distributors for Public Works Uses

376. New "Road Builders" bulletin includes description of distributors 1000 to 1500-gallon capacities, including the Model 638 with "compact car" design, plus tar kettles, spreaders, and construction brooms. A lot of good information. Bulletin SE-60-25M, Standard Steel Works, Inc., North Kaneas City 16, Mo.

Tractors and Equipment for Municipal Use

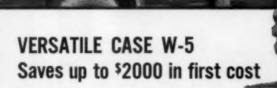
407. Specification sheets for the John Deere crawler and utility wheel tractors; also equipment for loading, dozing, mowing, sweeping and many other operations. John Deere, Industrial Division, Moline, III. Check the reply card, State type of tractor and equipment.

Self-Propelled Ditching Machines

438. Information on a self-propelled one man orerated ditching machine, model 524 T. model W-2 and a new midget ditcher, model 4 T. for light construction is now available from the Vermeer Mfg. Ca., Pella, Iowa. The Model 524 T diga 8 to 24 inches wide and down to 6 feet deep, while the model 4 T diga 6 to 14 inches wide and down to 4% feet deep. Model W-2 Ditcher diss from 2° wide up to 4° down to a depth of 30°. Full data on these ditchers available by checking the reply card.

Budget ? Minded?

Get the 1-yd loader that COSTS YOU LESS... SAVES YOU MORE!



THAT'S RIGHT! You pay up to \$2000 less for a 3000-lb capacity Case W-5 than for comparable 1-cu yd loaders — or even for TWO smaller capacity conventional wheel-rigs. Yet the high-speed W-5 will move more pay yards per day because it is engineered specifically for loading and stockpile work. In addition, all major components — including engine and transmission — are quality-built by the J. I. Case Company, instead of being purchased from "outside" sources.

Keeps on saving AFTER you own it!

Important—any man in your crew can run a Case W-5. You don't need a high-priced "specialist". Automatic torque converter, plus power-steering and forward-reverse shuttle-shift, make operating a "breeze". A single foot-pedal actuates king-size brakes and clutch simultaneously. Two foot-throttles let you use either foot—to accelerate travel speed, or "rev-up" the engine for faster hydraulic action. Double-heat-treated, high-clearance axles and other quality features cut repair expense to rock bottom.

Get the "feel" of a W-5's unequaled hydraulic loading action, perfect balance and new safety-engineered lift-controls. Ask your Case Industrial Dealer to put you in the driver's seat — today. Or write J. I. Case Co., Dept D1341, Racine, Wis. for full information.

Operators feel "safe and sound" in the W-5's clean, roomy cockpit. Loader arm design permits unobstructed vision and protects operator by eliminating dangerous shearing action of lift-arms and cylinders. All controls are within easy reach — and as simple to operate as a modern car.

Available with Case-built Diesel

Thrifty 57 hp Dynaclonic Diesel offers added savings through unbelievably low fuel consumption and long, trouble-free operation.

Choice of 3 LARGER SIZES

For high-production digging and loading, Case also offers three larger 4-wheel-drive loaders with extra power, extra capacity, extra safety features. See them at your Case Dealers.

- W-9 5500 lb capacity with 1 % to 2 % cu yd buckets.
- W-10 6500 lb capacity with 2 to 2% cu yd buckets.
- W-12 9000 lb capacity with 2½ to 3½ cu yd buckets.

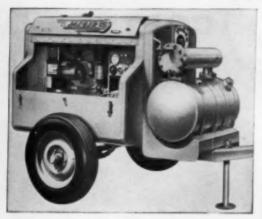
CASE

J. I. CASE CO., RACINE, WIS.

To order these booklets check card opposite page 34.



75 cfm operates a heavy breaker at top efficiency.



All the air you need for an 80 lb. breaker JAEGER ROTARY "75"

Easy starting in coldest weather because it has no pistons to drag. Costs less than the reciprocating model it replaces, yet runs smoother, delivers much cooler air, has fewer parts. Fully equipped. Big tool boxes, automatic blow-down valve. Ask your Jaeger distributor or send for Catalog.

The Jaeger Machine Company, 400 Dublin Ave., Columbus 16, Ohio 75 • 85 • 125 • 250 • 365 • 600 • 900 CFM ROTARY COMPRESSORS

Quality pays



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IS BETTER BUILT TO GIVE YOU MORE PERFORMANCE

You get more trench for your money—day in and day out—and at less cost with an AUBURN. Simple and rugged in design, it's virtually trouble-free. Its variable hydraulic drive automatically adjusts the speed to changing soil conditions. One man operates it digging up to 800' per hour, 6" to 14" wide and down to 6' deep.

Write us for literature and the name of your nearest AUBURN dealer.

AVEVRN MACHINE WORKS, INC. 2045 South J Street, Auburn, Nebraska, U.S.A. Phone: BRidge 4-3141



World's Finest Official Board
Rugged Aircraft Girder Construction,
Unequaled in Design, Durability and
Performance by any board built today.
Exclusive International Distributors



Features of the Traxcavator

452. Design features of the Caterpillar 922 Series A Traxcavator are covered in a 12-page booklet that tells why this machine is a top producer yet provides greater operator safety and convenience together with ease of maintenance. For your copy write to Caterpillar Tractor Co., Peoria, Ill., for Booklet 34004 or check the inquiry card.

Manual

on Construction Castings

462. This 168-page Manual covers catch basin inlets and traps, building castings, manhole covers and steps, flap valves, wheel guards, drainage grates and many other construction and maintenance castings. Check the reply card or write Neenah Foundry Co., Neenah, Wisc., for your copy.

Pneumatractors, Their Tools and Accessories

499. These machines, applicable to a multitude of jobs, are comprehensively described in a folder that every public works official and engineer will find revealing and useful, Ask for Catalog 5945 from Schramm, Inc., West Chester, Pa., or ring the number on our eard.

Design Manual on Sectional Plate Pipes, Arches and Pipe-Arches

550. Size and weight tables, minimum gages for live load strutted and unstrutted, layout details and plan developments are some of the material covered in this manual. Write American Bridge Div. United States Steel Corp., 525 William Penn Place, Pittsburgh, Pa.

Public Works Equipment for Everyday Use

578. How many everyday public works needs can be met by the products of one company is the basic content of this brief but informative brochure. Inform yourself with a copy of it. Address Allis-Chalmers Mfg. Co., Box 512, Milwaukee 1, Wisc., or ring the number on card herewith.

"Rip the Daylights out of Masonry Sawings Costs"

435. What to do it with is fully described in new literature "New from Truco" on drilling machines, bits and accessories; also concrete, masonry and stone saws and diamond blades. Address Truco Masonry Drilling Division, Wheel Trucing Co., 3200 West Davison, Detroit 38, Mich., or circle number on our card.

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538. A new pocket-size booklet describes and illustrates all the good things Wyandotte Calcium Chloride can do for your concreting in faater hardening, high early strength, increased final strength and workshility—to name but a few. Get your copy from Wyandotte Chemicals Corps. Wyandotte, Mich., or circle the number above.

Versatile Crawler With Power and Controlability

707. Within this 24 page booklet (Form No. 607R) are liberally illustrated descriptions of the features of the Euclid C-6 for clearing, dozing, stripping, grading and a variety of other applications. Specifications covered. Circle reply card or write to Euclid Division of General Motors Corporation, Cleveland 17, Obio.

WEED CONTROL

Chemical for Roadside Weed Maintenance

234. Garlon is an easy to prepare and to use chemical in the control of roadside weeds and growth. For complete data write The Dow Chemical Co., Agricultural Chemicals Sa¹45, Midland, Mich., or check the reply card.

Don't Fool Around with Weeds -Eliminate Them

599. With Amizol and Amizol combinations, advantages are better kills, lower costs, longer spraying seasons. For full-color brochure that tells the whole story of better weed and vegetation killing, address AMCHEM Products, Inc., Ambler, Pa., or circle card-number.



F-M

DEEP WELL TURBINE PUMPS

An F-M exclusive! Brand new impeller design will increase pumping capacity 35% to 40%! Result ... you can move more cubic feet of water per second—at greater savings!

F-M Deep-Well Turbine Pumps can meet your city water needs with fewer pumps . . . smaller motors. This adds up to extra savings!

F-M Deep-Well Turbine Pumps are smaller, more flexible, and far more efficient. Sizes range from 4" through 48" in diameter. Units are available in semi-open impeller construction or enclosed impeller construction.

Like all Fairbanks-Morse products, these new Deep-Well Turbine Pumps hold operation and maintenance costs to a minimum. And—you can count on continuous operation because of famous Fairbanks-Morse service—available all the time—anywhere.

For further information on Fairbanks-Morse new Deep-Well Turbine Pumps, write: Pump & Hydraulic Division; Fairbanks, Morse & Co.; Kansas City, Kansas.

FAIRBANKS MORSE

A MAJOR INDUSTRIAL COMPONENT OF

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SEEN IN ALL THE WORST PLACES

PLACES

They keep showing up in places most trucks can't get to because it takes an awful lot to stop these sure-footed Chevy four-wheel-drive models! Where the job calls for the mobility of a mountain goat teamed with the stamina of a mule, you'll find no finer way to get your work done. And for 1961 the Chevrolet 4-wheel drive lineup is a full dozen models long. You can pick from a wide selection—one that's sure to include the best answer to your toughest traction-plus requirement!

■ Put any one of these 4-wheel drive Chevies on any job—then watch it dig in and go! Come what may in the way of mud, snow, sand, loose gravel, creek bottoms, swampland or freshly plowed ground, you can rest assured that the extra bite of up to double traction—plus stump-jumping road clearance—will get you through every time.

And you'll like the way a Chevy 4x4 rolls down the highway in smooth 2-wheel drive, ready to give you 4-wheel traction at the flick of a lever, the moment you need it. You'll appreciate the no-clutch shifting ease of the transfer case (whether moving or standing still) and the extra versatility that's yours with a choice of 4-wheel direct or underdrive.

If you prefer the extra snap of spirited V8 power, it's yours at nominal extra cost in any model. Also available at extra cost are heavy-duty 3-speed and 4-speed transmissions and a wide choice of traction tires. You can tailor your Chevy 4 x 4 to fit your needs exactly. Get the full details and turn your traction problems over to Chevy—the traction champ of them all!... Chevrolet Division of General Motors, Detroit 2, Michigan.

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| Model K1434 K1534 K2534 | Max. Load 1400 lb. 1300 lb. 2950 lb. | Body Length 634 ' 8' | Model K1404 K1504 K2504 | Max. Load 1450 lb. 1350 lb. 3050 lb. | Body Length 6% ' 8' | Model K1403 K1503 K2503 | Max. Load 1900 lb. 1850 lb. 3500 lb. | Wheel- base 115" 127" 127" | Model K1405 K1406 K1416 | Mex. Load 1300 lb. 1000 lb. 1000 lb. | Body Type 7½ Panel Carryall (penel type rear doors) Carryall (tailgate and liftgate) |
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1961 CHEVROLET STURDI-BILT TRUCKS CHEVROLET

Two of four purification units at Lexington, Kentucky—each 69' 8" dia x 17' 9" high—for American Water Works Service Co.



The projects pictured typify the long experience of PDM in serving dependably the waterworks field. The same care and skill in construction that have made PDM elevated steel tanks, standpipes and reservoirs the standard of value and performance wherever water is stored, apply equally to the long-lived steel structures PDM builds for modern water filtration and purification. • When

water filtration and purification. • When water handling is your problem, you'll find the best solution begins with a call to Pittsburgh-Des Moines!



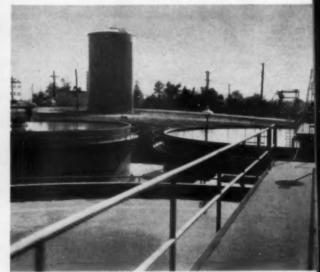
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Plants at PITTSBURGH, WARREN, BRISTOL, PA. • BALTIMORE • BIRMINGHAM • DES MOINES PROVO, UTAH • CASPER, WYO. • SANTA CLARA, FRESNO, STOCKTON, CALIF.

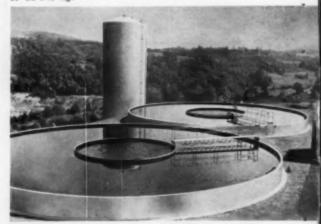
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CRAFTSMANSHIP AND PERFORMANCE IN STEEL WATER PURIFICATION AND FILTRATION FACILITIES BY PITTSBURGHDES MOINES



Lexington, Kentucky installation with 200,000 gallon standpipe, 28' dia x 45' high



Two of four water treating units at Greensburg, Pennsylvania—each 84' dia x 18' high—and 300,000 gallon standpipe, 28' dia x 65' high, for Municipal Authority of Westmoreland County, Pennsylvania.

These Comparisons Show Why CAST IRON PRESSURE PIPE is America's No. 1 Tax Saver

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| POINTS TO COMPARE | CAST IRON PIPE | NON-FERROUS PIPE |
| Long Life | 100 Years or more | ? |
| Bursting Pressure | 2,988 psi | 746 psi |
| Bursting Tensile | 25,880 psi | 3,430 psi |
| Impact Resistance | 234 ft. lbs. | 60 ft. lbs. |
| Beam Loads (12-foot span) | 20,790 pounds | 3,060 pounds |
| Crushing Loads | 17,900 lbs. per ft. | 6,480 lbs. per ft. |
| Water Absorption | None | 9.8% of weight after 24-hour submersion |
| Tight Joints | Wide selection for liquid or gas service | Limited selection for liquid service |
| Inside Diameter | 6.14'' | 5.85′′ |

- and also why CAST IRON PRESSURE PIPE actually COSTS LESS

This advertisement published in the interests of the Cast Iron Pressure Pipe Industry by



POKER? Play to win!



How would you play this hand?

Odds are 50-50 you're high hand before the draw. Open, or if you're to left of opener, raise. Don't stay on less, though. Queens or under most times are drawing against a better hand.

Here's a <u>sure</u> winner from FORD:

Two <u>new</u> Ford Tractors built for half-yard loading, for 10 ft. or 12 ft. digging!

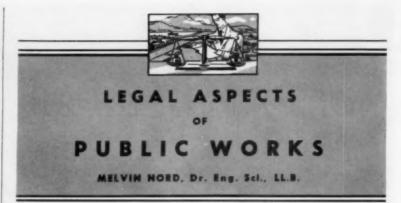
New 4000 Series Industrial Tractor for work demanding up to 42 drawbar horsepower; new 2000 Series for work requiring up to 32 drawbar horsepower.

Gasoline or diesel, choice of transmissions, job-matched with dozens of front, side and rear attachments.

Get details from your Ford Tractor Dealer, or write:

Tractor and Implement Division Ford Motor Company Birmingham, Michigan





Road Construction

Mapes v. Madison County, 107 N.W. 2d 62, an Iowa case decided Jan. 11, 1961, was an action by a farm owner against the county and the board of supervisors to compel them to bring an additional condemnation proceeding to pay for damage caused to the farm through a change of the road after a first condemnation.

The county decided in 1959 to convert a country road running past plaintiff's farm into a farm-to-market road. They needed a tract of 1.88 acres to widen the road, which was located in the corner of plaintiff's 160 acre farm. This tract was condemned, and an award of \$825 was made. The road was widened, raised 14.5 feet, and completed in the summer of 1959.

Plaintiff claimed damages for a number of reasons, one of which was failure to provide lateral support for the road. It was alleged that the defendants performed the work in such manner that after every rain a portion of the fill would slide down and move over onto plaintiffs property.

The Supreme Court of Iowa held that this damage was not within the contemplation of the original award, and that an additional award would therefore have to be made.

City Sewer System

Lore v. Town of Douglas, 355 P. 2d 367, a Wyoming case decided Sept. 16, 1960, was an action by the owners of a frozen food locker plant for an injunction and damages resulting from the flooding of their basement when the town flushed adjacent sewer lines, allegedly in a negligent manner. There was testimony to the effect that "the cause of the flooding was a clogging back behind the line that goes into the

main sewer . . . it fills up with sand . . . from . . . wash racks."

The town defended on the ground of immunity from tort liability.

The court held, however, that sewer maintenance is a proprietary function, rather than a governmental function; hence the city had no immunity.

Appropriation of a Street

Doering v. City of South Euclid, 170 N.E. 2d 87, an Ohio case decided Nov. 3, 1960, was an action to enjoin a city's appropriation of a portion of a street for use in construction of a water control retention basin.

Langerdale Boulevard is a paved street on both ends of an 1100-foot section which runs along the bottom of a ravine. This section was dedicated as a public highway in 1926, and there was installed in it an 8-inch water main, a 10-inch sanitary sewer, and a 36-inch storm sewer. The "street" was never otherwise improved. At the time of the hearing, it was grown up with underbrush and had the appearance of never having been used as a highway.

The City planned to build a dam across this section of the "street", which would be 25-30 feet high and 30 feet wide, as part of a water control retention basin. This would completely destroy any possible use of this section of "Langerdale Boulevard" for highway purposes.

The court held that the City lacked the legal power completely to block a public highway so as to destroy its use for highway purposes. The fact that the City had "failed to carry out its obligation to improve this part of the boulevard for vehicular traffic" could not redound to its benefit, according to the court. The court noted that the "street" had been continuously used

the way WITH ZEP R-59 WEED KILLER

Penetrating deep into the soil, killing buried seeds and rootings...stopping weed troubles before they start...keeping areas weed-free longer... Zep R-59 Weed Killer clears the way to rigid weed control around municipal buildings and other property.

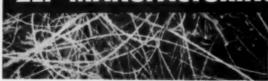
Zep-R-59 is actually the most economical method of municipal weed control there is. Highly concentrated, it is easier to handle and store... so powerful that just a little goes a long way, (even diluted 40 times with water it is *still* strong enough to do a complete job) you need to buy it less often. In addition, Zep R-59 cuts labor and equipment costs in maintaining city property.

MANY cities have made Zep R-59 a regular part of their maintenance programs...putting it to such uses as clearing weeds from grounds around buildings, parking areas, vacant lots, driveways, rights-of-way, and road shoulders.

For a FREE demonstration of Zep R-59 and its place in your maintenance program, contact your nearest Zep Maintenance Expert, or write us direct, you'll have an immediate reply.

FIRST in Maintenance and Sanitation

ZEP MANUFACTURING CORPORATION



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BIRMINGHAM CLEVELAND
3605 Third Ave., S. 13112 Broadway

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Save as you buy, as you work

...WHEN YOU USE A TASK FORCE OF SCHRAMM CO-ORDINATED AIR-POWER EQUIPMENT

You save for two reasons: First, each Schramm unit costs less to buy, to operate, to maintain. Second, the Schramm line has been planned as a work-together team; you actually buy fewer pieces of equipment for a complete range of projects.

A case in point . . . Schramm Pneumatractor. Here is a multipurpose tool if there ever was one. Combines compressor and tractor, so right away your air power is self-propelled. Moves along with the job quickly, more of your equipment time is spent working, not travelling. Pneumatractor not only operates air tools but, with accessories, loads, trenches, grades, and so on. One man can do all this. Pneumatractor costs less than a combination of these units bought separately.

You'll find other bargain performances throughout the SCHRAMM line because equipment has been designed as a task force. Maintenance costs will shrink since all SCHRAMM products are designed with maximum interchangeability of parts between engines and compressors, between products, between sizes. The more SCHRAMM units you own, the more your savings multiply! Talk to your SCHRAMM dealer. He's listed in the Yellow Pages. Or write for our new booklet on saving with a SCHRAMM task force of co-ordinated air-power equipment. SCHRAMM, Inc., 766 North Garfield Ave., West Chester, Pa.

SCHRAMM CO-ORDINATED AIR POWER



Stationary Compressors. Electric motor or V-belt drive. Vibrationless operation, no foundation needed. They're compact, easy to move. Easy to relocate to meet emergencies.



Presumatructor Sett-propelled Compressers cost less than comparable compressors and tractors combined! PNEUMATRACTORS drive along with the work. No trucks, crews, tied up.



Pertable Compressors save you up to 35% initial cost on 125 cfm compressors, comparable savings on every size from 20 cfm to 600. You also save 15 to 50% fuel consumption.

(since 1926) for sewer and water services to the surrounding territory, and it still constituted a highway or street.

The plaintiff, as taxpayer, was therefore granted an injunction to prevent the construction of the drain water retention basin, until the "street" has been vacated as a public highway in a proper legal proceeding.

Obstructions in Drainage Ditches

Young v. City of Scribner, 106 N.W. 2d 864, a Nebraska case decided Dec. 30, 1960, was an action by a property owner to compel the city to remove certain obstructions in the city drainage ditches near the owner's property, and to enjoin the city from casting surface waters on his property.

It was undisputed that plaintiff's property had never flooded between 1944 and 1957. A church was constructed nearby in 1956. A portion of the roadside ditch adjacent to the church was filled in without any culvert, although sewer and water pipes were buried under the driveway. The City also placed asphalt on the street adjacent to the church property, and this was also found to have increased the flow of surface water down the ditch from the church property and driveway over the end of plaintiff's property. The surface water also overflowed over the asphalted street to an inadequate culvert near plaintiff's property, where accumulations of water backed up and flooded his property and seriously damaged or destroyed his garden, strawberry and raspberry crops, and other property. As a matter of fact, his property was so flooded three times in 1957 and twice in 1958.

The court held that the City had created a nuisance on plaintiff's property, and that he was entitled to an injunction.

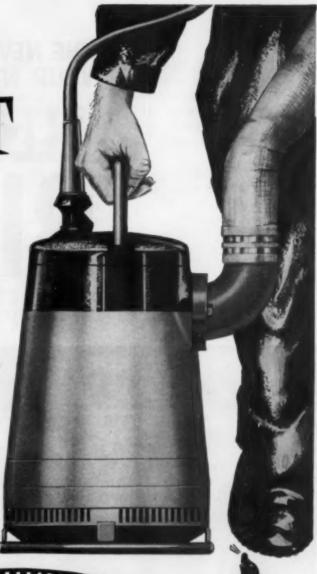
Planning and Zoning Courses at Georgia Tech

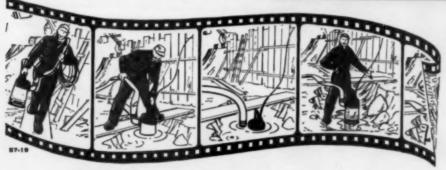
A new pair of courses will be held at Georgia Institute of Technology, Atlanta, Ga., in July. One, a basic course in city planning, will run from July 17 to 28; the other, an advanced summer institute in zoning, will be held July 24 to 28. Programs will be available shortly. Write Director, Short Courses and Conferences, Georgia Institute of Technology, Atlanta 13, Ga., for full details on these new courses.

It's Here... The First COMPACT IN PUMPING

Bibo 3"

You can't discount experience, satisfied users or mounting sales. The world's first submersible "dirty water" pump was designed by "Flygt" in 1946. Ever since, thousands of customers the world over are relying on economical "Flygt" performance. Recently competition has followed the lead established by "Flygt", confirming the superiority of in-the-water pumps. Advanced research, imaginative engineering and manufacturing know-how plus 15 years of field testing result in "Flygt" quality. There's a "Flygt" for every job - 1½" to 8". NOW the NEW Bibo 3" COMPACT, weighing only 88 lbs., delivers 20,000 GPH. Only "Flygt" could offer you a pump like the Bibo 3". Do yourself a favor, see it in action on your next job. One more important point . . priced to greatly reduce pumping costs.







Available in 220-440V. and 550V. also 220V single phase



ORIGINAL MANUFACTURERS OF ELECTRIC SUBMERSIBLE 'DIRTY WATER' PUMPS!

orporation HOOSICK FALLS, N. Y.

WESTERN SALES & SERVICE: STANCO MFGS. & SALES INC., 1666 Ninth St. (Corner of Olympic) Santa Monica, Calif. - IN CANADA: FLYGT CANADA LIMITED, Montreal, P. Q.

PUMP BETTER ELECTRICALLY, USE FLYGT!

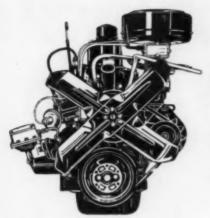
THE NEWEST REASON TO MAKE YOUR NEXT 2-TONNER A FORD

ALL-NEW FORD BIGSIX 262 PM. TRUCK ENGINE



FORD DIVISION, Ford Motor Company,

New two-ton toughness! New stronger frame...huskier cab...rugged truck suspension that can give up to twice the tire life of other types!



Now, the rugged simplicity of a big 262-cubic-inch Six is combined with the dependability of heavy-duty, exclusive-truck engine design. In a grueling 40,000-mile test of reliability, Ford's new Big Six was pitted against its principal competitor in the 2-ton field. Result: Ford's new engine required fewer service adjustments. This means less time in the shop... more time on the job.

The new Big Six is one of *four* engine choices in Ford two-tonners for '61—including America's most popular truck V-8's. See your Ford Dealer. He will be glad to help you select the best engine for your job.

SEVEN MORE REASONS

WHY IT'S GOOD BUSINESS TO DO BUSINESS WITH FORD!

You save from the start with Ford's traditionally low prices! And your savings continue with lower operating and maintenance costs. These facts are documented by certified test reports from America's foremost independent automotive research firm. Ask to see these reports. They're on file at your Ford Dealer's.

In addition to these actual dollar-and-cents savings, the following bonus benefits provide greater protection against those annoying problems that are often associated with truck ownership.

1. Rigid quality controls give you the strongest safeguard of truck quality ever. One tangible result of these new and uniformly high standards is Ford's liberal new warranty program. Other results: extended durability and performance, lower operating costs.

2. 12,000-mile warranty (or 12 months) on all 1961 Ford Trucks of any size. Each part, except tires and tubes, is now warranted by your dealer against defects in material or workmanship for 12 months or 12,000 miles, whichever comes first. The warranty does not apply, of course, to normal maintenance service or to the replacement in normal maintenance of parts such as filters, spark plugs and ignition points.

3. Exclusive 100,000-mile warranty (or 24 months) on 401-, 477- and 534-cu. in. Super Duty V-8 engines. Each major engine part (including block, heads, crankshaft, valves, pistons, rings), when engine is used in normal service, is warranted by your dealer against

defects in material or workmanship for 100,000 miles or 24 months, whichever comes first. Warranty covers full cost of replacement parts . . . full labor costs for first year or 50,000 miles, sliding percentage scale thereafter.

4. Special fleet financing, available for owners of two or more trucks, provides the opportunity to precisely tailor payments to your income patterns or depreciation schedules. Let your Ford Dealer explain how this fleet truck finance plan offers substantial savings and frees your working capital.

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From Super Economy pickups to Diesel-powered tractors, you can now fill every truck need up to 76,800 pounds GCW with a modern, money-saving Ford Truck.



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PAYLOADER with exclusive 4-in-1 Bucket handles jobs that are

impossible

for any other rubber-tired tractor-shovel

"It's always busy as it can do the jobs of several pieces of equipment," says a superintendent in explaining how their PAYLOADER with Drott "4-in-1" Bucket reduces equipment investment as well as the amount of manual work required on many projects.

The "4-in-1" Bucket — an exclusive on Payloader units in the rubber-tired class — expands the usefulness of a tractor-shovel to many clamshell, bulldozer and scraper applications. With the clamshell action, you can also load the bucket without forward motion of the tractor — can pick-up large or small piles of dirt cleanly and eliminate slow, manual clean-up operations . . . can grip and handle stumps, boulders and slabs easily.

There are many other attachments that you can have for your PAYLOADER so that it can do the work of other specialized single-purpose machines. Consider the potential of a PAYLOADER — plus one or more of the following tools — to hold down your equipment budget and get necessary work done with a minimum expenditure of time and labor.

Side-boom — an exclusive on PAYLOADER units — lifts up to 6 tons at 4 ft. overhang; has double-acting, hydraulic-power boom extension; does not interfere with the bucket use; can work on pavement without damage, and is available for three PAYLOADER sizes.

Backhoes are available for front or rear mounting on several PAYLOADER sizes and are recognized as the best-engineered in the industry. One of these can be rear-mounted on several PAYLOADER sizes along with the Sideboom and "4-in-1" Bucket, and any of these three tools can be used on the same job.



Sideboom, backhoe and bucket can all be mounted and used on the same PAYLOADER.

Blacktop Spreader interchanges with the bucket and has its own engine power. With hopper capacity of 2 cu. yds., it lays hot or cold mix up to 8-ft. wide and up to 6-in. thick — instantly adjusts for widths up to 4 ft.

Pick-up Sweepers are interchangeable with the buckets on several PAYLOADER models and can dump their loads directly into trucks. Separate hydraulic motors drive main and gutter brooms.

Snow Plows of all types are available, interchangeable with the bucket, including one-way, Reversible, Vee and self-powered Rotary types.

Other PAYLOADER Attachments include hydraulic earth augers, vibratory compactor, fork-lifts, winches, backfill and angling blades. Your Hough Distributor is ready to show you how a PAYLOADER can work economies all year 'round.

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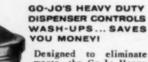
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CARELESS WASH-UP PROCEDURES ARE COSTING YOU MONEY!

A pair of dirty hands with free access to an open can of soap may well be the reason your company handcleaning bill is such a costly item. Provide an effective way of controlling the amount of soap being wasted by your employees, and you'll prevent the greatest part of your handcleaning dollar from being washed down the drain.





Designed to eliminate waste, the Go-Jo Heavy Dispenser delivers just the right amount of Go-Jo to get even the grimiest hands spotlessly clean. Go-Jo Creme Hand Cleaner is a concentrated formula containing GT-7 for dermatitis promatitis

tection, plus soothing emollients to prevent chapping. When used in the Heavy Duty Dispenser, it provides four times as many clean-ups as "hand scoop" methods.

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The Go-Jo jobber serving your area will be happy to show you how to cut as much as 75% off your handcleaning expenditures. Write us today.

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Nearest thing to power-steering in a heavy-duty mower!

The new Roof Swivel-Glide mower is engineered to handle all heavy duty mowing requirements from heavy weed and brush cutting to spacious lawn areas.

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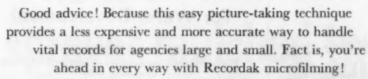
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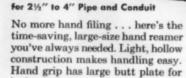
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Ed Cleary Says:

Delaware Basin Proposal Provides New Pattern For Water Development

EDWARD J. CLEARY

Diplomate, American Academy of Sanitary Engineering Cincinnati, Ohio

NEW VISTAS in water-resources administration are revealed in a proposal developed by the citizens of the Delaware River basin. They are presented in the form of an interstate-federal compact submitted just a few weeks ago to the Congress of the United States and to the legislatures of Delaware, New Jersey, New York and Pennsylvania for approval and ratification.

The compact would establish a commission to administer on a comprehensive basis all aspects of water use and development in the Delaware basin, including watershed management. The people of the valley, as represented by the governors of four states and the mayors of the two largest cities with vital interests in water supplies—namely, New York and Philadelphia—have asserted that they are prepared and willing to assume responsibility for guiding the destiny of such a venture.

This bold affirmation of acceptance of local and regional responsibility is in striking contrast to the prevailing mood for thrusting such tasks on an already over-burdened federal bureaucracy. The Delaware basin compact establishes the means for determination of policies and the execution of desires by those most vitally concerned—the people who live in the valley. It provides a mechanism for the integration of existing federal-agency interests in the valley—some 25 in all—but does not defer to federal jurisdiction in the planning, development and control of water resources. In brief, it recognizes the federal government as a partner, but not in the role of final arbiter nor subsidizer.

Origin and Development

From an administrative standpoint the water-resources situation in the Delaware valley—in common with many other river basins in the nation—has been described as representing a chaotic "multiplicity of agencies with a splintering of responsibilities". In addition to the 25 federal agencies in the basin there are 14 interstate agencies and 43 state departments, boards and commissions, that have a concern with some aspect of water resources. And there are more than 250 public and private water companies. In 1931 and again in 1954 the Supreme Court of the United States was called upon to render decisions with regard to allocation of Delaware River water to New York City.

This was the background that led the governors of the four states and the mayors of two cities to establish an advisory committee in 1955. The committee helped to promote formation of a citizens group, which sponsored a study by the Maxwell Graduate School of Public Administration of Syra-

Two men with one hydraulic sprayer mulched two acres of embankment in 24 minutes flat!

They were testing the remarkable new erosion control agent:

Right on a major expressway, a new concept in mulching proved itself. Where it would ordinarily take a crew of 5 men working 8 hours to blow straw mulch over 6 acres, SOIL-SET demonstrated it would do the job average and effectively could do the job evenly and effectively in 1/5 the time—and with less than half the labor.

Three full years of testing

This Eastern test was just one of hundreds. Before Alcoreleased new SOIL-SET for general use, it embarked on a comprehensive on-the-job proving program
... working with over 20 state highway
departments, parks, commercial farms,
golf courses, country clubs, industrial
and residential developments. SOIL-SET performed with specific plusses not to be found in other mulches.

SOIL-SET is always "ready to go"
If you've had to sweat out delivery of truckloads of straw, while you kept crews waiting idle, you'll appreciate the news that SOIL-SET can be stored on the site for any length of time . . . ready for the instant you need it. Because it's a concentrate (1 gallon properly diluted with water covers up to 500 square feet) a few drums of material are all you will need for most jobs. Rain won't spoil it. It won't deteriorate with age. When your men are ready for the mulching, just add water and SOIL-SET is ready to spray.

SOIL-SET is a "clean" application

SOIL-SET is a "clean" application Unlike the problems you encounter in blowing straw, SOIL-SET sprays on easily, exactly where you want it, without clogging machinery. This is a strong contributory factor to its speed of application. In addition it is available, not only in green or black, but in a clear mix that won't stain paving or metal work.

SOIL-SET is organically inert
Where straw will, as it deteriorates, rob
carefully prepared soil of nitrogen,
SOIL-SET will not. On the contrary, an
application of SOIL-SET will "hold" the chemicals and fertilizers you may have added with seeding. Furthermore, SOIL-SET adds no unwanted cereal and weed seeds. Only the seed you actually plant will germinate.

SOIL-SET is non-flammable

Don't worry about a careless match after you apply SOIL-SET. Where straw mulches can present so great a fire hazard that many communities forbid their use, SOIL-SET is perfectly safe. This means you can now protect seeding in any area.

Just what is SOIL-SET

It's an entirely new concept of mulch— an elastomeric emulsion that forms, after spraying, a close-fitting porous ground cover that lasts about 60 days. It can be applied with any standard sprayer, and at temperatures as low as 45°F.

SOIL-SET is specifically

designed for erosion problems Wherever wash-aways are a problem, SOIL-SET is the answer. On grades, em-SOIL-SET is the answer. On grades, embankments, slopes, hills, run-off areas and depressions, SOIL-SET will hold soil, seed and chemical fertilizers in place—even against high winds and heavy rains. As a side benefit, if a cool spell occurs after spraying, SOIL-SET will also accelerate seed germination because it retains the sun's heat.

Don't guess about SOIL-SET; read the



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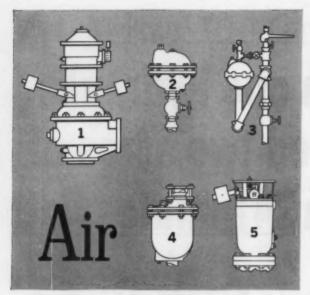
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How to protect your pipelines from too much or too little of it

1 Prevents water hammer: Type CCAV Controlled Closing Air Valve protects against damaging effects of surge and water hammer. Combines functions of an air inlet valve (vacuum breaker) and a controlled closing unit (to prevent sudden water stoppage and subsequent water hammer). 4" and 6" sizes. Capacities from 575 to 5980 gpm. Send for Bulletin 1225.

2 Removes excess air: Type AGFD Automatic Air Release Valve prevents stoppages due to air-lock at high points in line. Has large discharge capacity, excess power to insure opening of the valve against high internal pressure. Can be equipped to hold vacuum, preventing re-entry of air into pipeline through valve. Furnished with 2", 1½" or 1" inlet diameter. Standard valve operates to 250 psig—special to 300 psig. For details, send for Bulletin 1206.

3 Protects sewage pipelines: Type "B" Air Release Valve, special for lines carrying sewage or sludge, removes entrained air and gases. Special trap catches sludge, prevents fouling of air-release valve. Relatively simple back-flushing cleans out this trap, maintains top efficiency and protection. Valve itself is same as Type AGFD. Details are in Bulletin 1206.

4 Provides three functions: Type AV Air Release and Air Inlet Valve performs three operations, combines great protection and single-unit economy: (1) Automatically releases accumulated air, (2) admits air to break vacuum, and (3) vents pipeline to permit escape of air when filling system with water. Standard units operate to 150 psi. For full details, send for Bulletin 1205.

5 Breaks vacuums: Type VAC Air Inlet Valve solves two serious pipeline problems: possible collapse of pipelines due to formation of vacuums—and stoppage of flow, caused by air binding, when lines are being filled. Standard units have 4" to 10" inlet diameters, can be assembled in groups to do the work of one large, expensive valve. For 16 pages of detailed information, send for Bulletin 1202.

SIMPLEX

a division of PFAUDLER PERMUTIT INC. Lancaster, Pennsylvania cuse University. The Syracuse report culminated in an assignment given to the advisory committee in September, 1959, to draft legislation for the creation of a basin agency by interstate-federal compact.

More precisely, the committee was handed the task of determining how government in the basin should be organized "to develop and administer water resources so that all interests dependent upon these water resources could be assured of having enough water of good quality, but not too much, when and where it would be needed in the years to come."

Meantime, the Corps of Engineers was completing a comprehensive study, begun three years earlier, looking toward the formulation of a physical plan of water development. The drafters of the compact agreed that this \$2,000,000 Army Engineer survey would be accepted as the first comprehensive developmental plan of the proposed basin agency, and they devoted their energies to the complex task of devising an administrative structure to execute the plan.

Structure and Powers

From the labors of this advisory committee emerged the unique proposal for establishing an interstate-federal agency to be governed by five commissioners. Members of the commission are the governors of the four states and one person appointed by the President of the United States.

Among other things, the commission would be empowered to:

(a) Adopt and keep current a comprehensive plan for development of water resources of the basin, and insure that all new projects or facilities having a substantial effect upon waters of the basin are carried out in conformance with this plan.

(b) Work with and through existing federal, state and local agencies—or directly when necessary—in planning, constructing, operating and maintaining dams, reservoirs and other facilities as well as conduct other programs, for the purposes of: Flood-damage reduction; water-quality improvement; municipal, industrial and agricultural water supply; recreation and fish and wildlife improvement; hydroelectric power generation; and soil conservation, forestation and watershed management.

(c) Make future allocations of the waters of the basin among the four states and their political subdivisions in accordance with the Supreme Court doctrine of equitable apportionment which takes into account alternative sources, relative needs, and changing uses. However, no allocation by the commission is perpetual, nor may it be deemed to constitute a prior appropriation of the water of the basin. Neither does the compact change present law relating to riparian rights.

(d) Regulate the volume of withdrawals or diversions in areas where serious water shortages threaten to develop, or in areas where an actual emergency shortage has developed.

Financing the Work

In devising principles for financing the program the advisory committee recognized there are two sources of funds—from the general public and from the direct beneficiary. In the first case, a governmental unit (federal, state or local) would provide funds without anticipation of repayment where the benefits are widespread and in the public interest.

Activated Sludge Thickened

(and more)

with Rex Float-Treat®

This remarkable thickening rate was obtained with two Rex Float-Treat Thickeners installed in two pilot unit tanks, 13'4" wide by 60' long, at the Bay Park Treatment Plant, Nassau County, N. Y

In fact, runs of substantial duration resulted in solids concentration greater than 5%-far exceeding the performance of the existing conventional gravity system. As a result of this performance record, six additional Rex Float-Treat Thickeners were purchased.

INCREASED CAPACITY...LOWER COSTS. Thickening with Rex Float-Treat Thickeners, as compared to gravity-type systems, produces much denser sludge concentrations, with far greater loadings. This results in two important advantages: 1. thickener tanks can now be much smaller; 2. with greater sludge concentration, overloaded sludge disposal facilities are relieved-or new facilities can be smaller.

EFFICIENT OPERATION. With Rex Float-Treat Thick-

surface, forming a highly concentrated sludge blanket. Skimmers move the thickened sludge to the end of the tank for disposal.

The Rex Float-Treat employs many unique features, including: thorough blending of an air-charged stream and raw sludge feed; positive distribution of solids-flow into the tank; two zones within the tank for more efficient flotation separation and sludge concentration; and generous sludge removal capacity. Air flotation thickeners with Rex Float-Treat permit classification into floatable organic solids and settleable inorganic solids.

For complete information, write CHAIN Belt Company, 4722 W. Greenfield Ave., Milwaukee 1, Wis.

eners, millions of tiny air bubbles float solids to the tank



Now, another cost-saving FRINK Sno-Plow combination! Uniting earth-moving with snow-removing, a grader equipped with a FRINK Sno-Plow gives year-around utility. A simple installation readies many graders for efficient winter snow-fighting.

The heavy-duty V-Type Sno-Plow with eight- or nine-foot cutting edge is attached in the same way as on trucks, with complete full-power hydraulic control. The driver has at his fingertips the standard FRINK quality of rugged, dependable operation.

For full details on making year-around cost-saving use of your graders with extraduty FRINK Sno-Plows, write: Dept. pw-461

- V-Type
- Roll-Over
- One-Way
- Reversible Trip
- Leveling Wings



FRINK Sno-Plows, Inc. Clayton, 1000 Islands, N. Y. Eastern Steel Products, Co. Preston, Ontario, Canada Where the beneficiaries can be specifically identified and the benefits are measurable (as, for example, in the sale of hydroelectric power) direct-user charges would be levied. Accordingly, the committee has proposed that the commission operations should be financed by:

A current expense budget to be apportioned among the signatory parties; appropriations, grants or loans from federal or state governments; issuance of revenue bonds; making reasonable charges for products and services; levying special assessments upon water users who receive specific benefits from stream flow regulation; and negotiating capital budgets when capital improvements are undertaken, with the sharing of costs among the signatory parties proportionate to the distribution of benefits from the proposed improvement.

What the Future Holds

What changes, if any, will be made in these proposals when it comes up for approval in the Congress and the four state legislatures cannot be foreseen. But it must be acknowledged that the drafters of the compact have contrived a unique framework for administration of a regional water-resources program. In so doing they have ingeniously resolved a host of major problems that are inherent in erecting a new structure on foundations long established.

The dynamic leadership shown in the Delaware Valley should give inspiration and direction to other river-basin groups who are grappling with the problem of how to manage water resources. Those who are interested would find it of value to obtain a copy of the compact document from Walter M. Phillips, executive secretary of the Delaware River Basin Advisory Committee, 930 Suburban Station Building, Philadelphia 3, Pa.

Engineering Notes

Costs of Sewer Construction

In Boulder, Colo., it cost \$4.45 per lineal foot for 1120 ft. 8-inch vitrified clay sewer in place. Trenching and backfilling cost \$2.50 per foot and the pipe and laying \$1.95. It cost \$3.77 to furnish and lay 843 ft. of 15-in. vitrified clay, including 85 cents for trenching and backfilling and 70 cents per foot for bedding. Standard manholes in place cost \$200 to \$210. In Englewood, Colo., 7 manholes cost \$226 each; 1429 ft. of 8-in. vitrified clay sewer cost \$1.32 per ft. for excavation and \$1.38 for pipe and laying, with wyes extra. In Pueblo, Colo., manholes 8 to 10 ft. deep cost \$190 each.

Research Assistants in Sanitary Engineering

Washington State University, Pullman, Washington, will expand its graduate program in environmental health (sanitary) engineering beginning in the fall of 1961. In addition to emphasizing water supply and waste water disposal, leading to the degree of Master of Science in Sanitary Engineering, a strong option in radiological health will be provided. New courses in sanitary chemistry and microbiology will strengthen the science foundation. Many of these courses are open to qualified students majoring in various sciences areas as well as to engineers. The instructional staff is being expanded



The T-340 has the capacity to handle stockpiling and clean-up work. Big 85-inch blade with 32-inch spillboard holds the heap. Operator changes the angle or tilt of the hydraulic Bullgrader® on-the-go without ever leaving the tractor seat.

You'd never expect to do so much with an "under 50 hp" crawler!

Even under the most adverse conditions the 47 hp* International® T-340 crawler is a heavy producer. More than three tons of drawbar pull or push are balanced with long track length for excellent traction and flotation in the worst footing. Handling ease with exclusive planetary steering helps the T-340 near the production of larger crawlers costing thousands of dollars more. Optional Fast Reverser almost eliminates gear shifting and slashes cycle time on shuttle-type work.

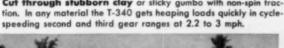
Ask your nearby IH dealer to demonstrate an International T-340 on your next job. You'll be surprised-and pleasedat how much work this rugged 47 hp go-getter will do.

*Maximum engine horsepower at standard conditions

5,000 dealers backed 12 parts depots

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Cut through stubborn clay or sticky gumbo with non-spin trac-





Precision grading ability of the T-340 helped slash stadium construction costs at the new Charlotte, N. C., stock car speedway. The IH crawler graded for 50,000 stadium seats.

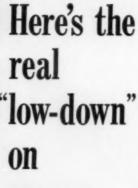


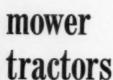


del G Tractor with nev gang Ram Lift Ranger



mechanical sickle bar







Worthington MODEL G TRACTOR DESIGNED EXCLUSIVELY FOR MOWING

You're looking at the tractor with the lowest center-of-gravity in the business. Rugged and powerful, it's built for the safety and comfort of the operator. Today's steep slopes and "impossible" grades are easily mowed with the Worthington Model G. Yet on the level it handles like a sports car-fast in transport (45 mph). Versatility is another feature, for when equipped with a hydraulic system it can accommodate Hydro-sickle bar as well as the new Worthington Ram Lift Ranger. Basically, the Worthington Model G Tractor handles 3-5-7 or 9-gang mower units. Also available is the utility dump body tractor model.

These are only a few of the features that enable you to cut the cost of cutting grass with the Worthington Model G. Call your dealer for a date to demonstrate.

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from two to five. Research assistantships are available for qualified candidates. These permit the student to carry two-thirds of a semester load of course work in return for twenty hours of project research. Work under way includes studies of the quality of return flows from irrigation, pesticides in natural waters, and anaerobic-aerobic sewage lagoons. Further information from G. H. Dunstan, Professor of Sanitary Engineering, Washington State University, Pullman, Washington.

Removing Sand and Gravel from a Water Filter

A procedure for removing sand and gravel from water filter beds was described in a recent issue of "Pure Water," issued by the Chicago Bureau of Water. A Morris centrifugal pump was used, with an 8-inch suction, reduced to 6 inches at the pump, and 6-inch discharge. The pump has a capacity of 1000 gpm with 900 feet of 6-inch piping, and a head of 145 ft. at the pump. A 60-hp. motor, directly connected to the pump shaft is used. The speed of the pump is 1180 rpm. The pump and motor are mounted on a steel platform for convenience in moving from one location to another.

The pump is placed in the filter pipe gallery close to the filter from which the sand and gravel are to be removed. The suction is 6-inch rubber pipe, except for a few feet at the end where iron is used for convenience in moving about in the filter. A chain hoist from a portable I-beam enables the suction end to be placed at any location and moved across the filter as the sand and gravel are removed. The discharge piping also is 6-inch, part rubber and the balance was 6-inch spiral weld steel pipe.

If the system is pumping 10 percent sand and gravel by volume, all of the material could be pumped from a filter of 1400-sq. ft. area in about 4 hours. It would be too much to expect this rate to be maintained continuously, for the suction of the hose could not be moved about that rapidly. After the piping is all connected, it would seem possible to remove all of the filtering material from a filter within two days. Considering the time for connecting the pipe and moving the pump, three to four days may be required.

Clogging may occur if the maximum size of gravel is more than one half the pipe diameter or of the opening in the impeller. Vertical rises in the pipe or steep slopes should be avoided.

Placing the gravel and sand back into a filter may require about 5 days or more. The gravel has to be replaced in layers, and it is essential that the layers be placed accurately.

Stump Removal Machine A Good Investment

A stump removal machine, purchased by Waterloo, Iowa, has proved "a wise investment," according to the annual report of Carl C. Fagerlind, Street Commissioner. In 1959, 107 stumps were removed from residential areas, for which the city collected \$1350; and 123 stumps were removed for the Park Board.

Trenching Costs for Sanitary Sewers

In Chapman, Kans., the bid price for trenching and ordinary backfill for sanitary sewer construction was: 120 ft., 0 to 6 ft. deep, \$1.00 per ft.; for 200 ft. 6.0 to 8.0 ft. deep \$1.50; for 334 ft. 8.0 to 10.0 ft. deep \$2.00. For 654 ft. of 8. in sewer in place, bid price was \$1.50 per ft.

SAN DIEGO GAS & ELECTRIC MEETS BOOM WITH BUCKEYE DITCHERS

Naval installations, airfields, production of missiles and jetliners—San Diego is booming, and bringing plenty of work to the San Diego Gas & Electric Company. Example: in 1959 alone 28,788 new dwelling units were built, all needing new gas lines.

To handle one of its toughest jobs—digging trenches for the new gas lines—the utility operates a rugged team of 12 Gar Wood-Buckeye ditchers. These machines are matching the speed of modern construction methods, and operating with precision, ease, and economy.

Since their introduction, the Gar Wood-Buckeye 305, 307, and 308 utility ditchers have become recognized as the most modern on the market. One reason is hydraulics—all three models are equipped with a hydraulic wheel hoist and hydraulic conveyor drive. All three have main engine transmissions specially designed for ditcher use. All three have a split-shaft excavator drive for longer working life. And all three are operated by the simplest group of controls on any ditching machine.

For more than 60 years Gar Wood-Buckeye has been the choice of contractors, cities, and utility companies that want fast, precise ditching at the lowest possible cost.



BUCKEYES ENGINEERED FOR TOUGHEST DIGGING



To meet fast production schedules through terrain as tough as San Diego's, the Gar Wood-Buckeye 305, 307, and 308 utility ditchers are more than just "ruggedly built." They are scientifically engineered to resist stress, to cut vibration to a minimum, and to deliver the greatest power to the digging wheel.

An all-welded panel truss frame supports the digging wheel and conveyor assembly of these machines—is exceptionally rigid and resistant to stress. The wheel itself is formed of two steel rings welded together for far greater strength. And the unique Buckeye digging buckets are of two-piece construction, for greater abrasion resistance and easier maintenance. Features like these are typical of Buckeye's extra measure of quality.

GAR WOOD INDUSTRIES, INC.





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Storm water will run through this mile-long culvert and not through the backyards of residents of Warren, Michigan. Serving as the Bear Creek Inter-County Drain, this giant sectional plate structure is built of 880 tons of USS AmBridge Sectional Plate Arches and Pipe Arches. Spans vary from 14 to 24 feet, and rises range from 8 feet to 11 feet. Greenfield Construction Co., Detroit, was the prime contractor. Sectional Plate was fabricated and erected by American Bridge. USS AmBridge Sectional Plate is strong . . . won't crack or break. Sections are prefabricated from tough, zinc-coated corrugated steel. They're highly corrosion resistant and simple and inexpensive to assemble. Installation is fast because forms aren't used. No need to wait out costly curing time. USS AmBridge Sectional Plate is available in a complete range of sizes and is fabricated to meet all federal and state specifications. American Bridge Highway Products are designed to add speed, strength, and permanence to highway and drainage programs. Contact one of our offices for literature and information on American Bridge Highway Products.

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Designed by Johnson and Anderson, Engineers

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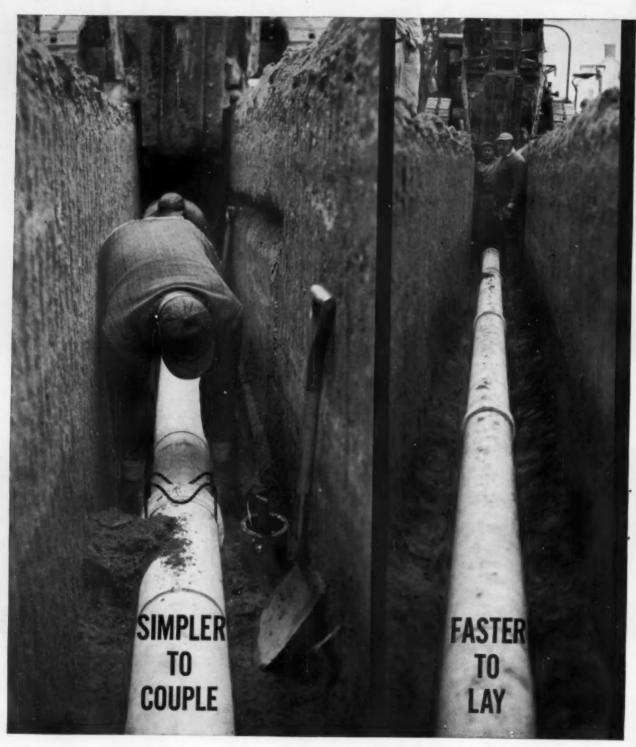
USS AmBridge Highway Beam Guard Rail and Posts help safeguard traffic. This rugged steel beam guard rail is easy to install and highly visible.



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"K&M" Asbestos-Cement Sewer Pipe installation, Mariton, N. J.; Engineers: Sherman, Taylor & Sleeper, Merchantville, N. J.; Contractor: Gray & Fear, Woodbury, New Jersey.



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Shown here are Model HD 14" size (left) and 2" size (right).

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\$35 Million Worth of Water System Deadlines— and more to come

ART F. VONDRICK
Assistant Water and Sewers Director,
City of Phoenix, Arizona

AT A SPECIAL election in May, 1957, the citizens of Phoenix approved a \$70 million bond issue of which \$35 million was for expansion of the City's water system. The first block of these water revenue bonds was sold in December, 1957, and now, less than four years later, all major projects in the construction program are completed or in the final stages of construction. This planning and construction has taken place at a rate of \$10 million a year. and though we have kept pace with and in some cases beaten the original schedule, the operation of the water system is continually meeting deadlines with the anticipation of more to come.

Although the original predictions of our growth were termed fantastic by some observers, the actual experience has exceeded those estimates. The original plan called for the extension of the water system from 72.5 to 147 square miles to serve a 1960 population of 423,000.



 SQUAW PEAK water filtration plant has a capacity of 90 MGD. Arizona canal and presedimentation basins in foreground; treatment units back of reservoirs.

It included the purchase of 5 private water companies, because of contemplated annexation plans. Actually, the present service area now covers 161 square miles with an estimated population of 480,000. Thirteen private water companies have already been acquired, and purchase negotiations are underway with two more, since the extension of the City limits has continued at a record pace.

The construction of a 60-MGD addition to the existing 30-MGD Squaw Peak Water Filtration Plant is a typical example of planning, engineering and excellent contractor cooperation that enabled the water system operation to meet its obligations without undue difficulty, but with plenty of worry and headaches.

Of the total \$35,000,000 in bond funds, over \$20 million were allocated for expanding production and transmission facilities. Even though a 20-MG storage reservoir, wash water storage tank and a 9½-MGD pumping station were constructed by separate contracts on the same site, the filter plant contract was the largest single contract involved in our program.

The part that this major works has played in meeting the challenge of a mushrooming metropolis is an interesting one, and the story is best begun by describing the Phoenix water system.

Description of System

The water supply is derived from multiple sources. About 30 miles northeast of Phoenix at the junction of the Verde and Salt Rivers is situated the 30-MGD Verde Water Filtration Plant, operated in conjunction with an infiltration gallery, and shallow wells. In 1952 the original 30-MGD Squaw Peak plant was constructed north of the City on the banks of the Arizona Canal, the large Northern Canal which furnishes irrigation water to the Salt River Valley farms. In addition, approximately 100 deep wells are operated in various parts of the system. The principal part of the City, including the downtown area, was served by gravity pressure from 3 major reservoirs having a total storage capacity of 60 million gallons.

In 1957-58, as the City annexed its rapidly developing fringe areas, private water companies were pur-

chased and integrated into the Phoenix system. Many of these areas are too high to be served from the reservoirs by gravity, and about 50 booster pumping stations are now operated to maintain adequate pressures for the consumers. Contracts were let almost simultaneously for the design of the filter plant additions and for a number of other large projects. John A. Carollo, Consulting Engineers of Phoenix who designed both original filter plants undertook the design of the Squaw Peak expansion. In July, 1957, the plant began to take shape on the drawing boards. Normally, planning for these large projects is done so that the facilities are completed and ready for service to meet the extended heavy consumer demand of the summer season. We can expect our high summer water consumption to start in April or May and extend through September. Because of the urgency of the Squaw Peak project, funds were actually borrowed from the budget to get the design under way before bond funds were available.

Phoenix water consumption figures are well above national averages; the per capita production has been determined to be 200 gallons per day on the average and 400 gallons for the peak day. The 1957 production capacity of the system was 104 MGD. Engineering studies made it evident that the peak day demand would equal the existing production capacity before 1960, and our best expectations were not to have the additional Squaw Peak capacity ready until the spring of 1960.

The Problems Commence

But the summer of 1958 arrived a little earlier than usual. This was only 3 months after acquiring 5 water companies. Without complete operating records and because of the unknown capabilities of facilities in these new areas, we knew not what to expect in the way of problems. Integration of these water systems with the older Phoenix system was incomplete, and we found ourselves operating several separate water systems rather than one. Even with handicaps we established new consumption records. This reflected, of course, the 35,000 services acquired with the water companies and the yearly 4,000 increase in services in the older area. The 1958 maximum daily consumption, occurring in July was 143 MG, with a peak rate of 206 MGD. These figures were significant to us, since together with the uncovered prob-



 MAIN operating floor in the new 60 mgd addition shown at the upper left on preceding page. Variable and sometimes very high turbidities need careful control.

lems they provided a new basis for projecting our estimated needs for the summer of 1960. Because of the great importance of meeting the peak summer demands, our production, storage and transmission facilities are designed to meet these peak loads and consequently during the winter months of low water use, a portion of these facilities are inactive. Adequacy of production facilities in the winter is no problem.

One thing in our favor was the confidence and knowledge that the original 30-MGD Squaw Peak Plant as well as the 30-MGD Verde Plant were capable of treating 40 to 45 MGD each, given a reasonably satisfactory raw water to treat.

In order to meet more easily the water demands that were certain to exceed the capacity of the existing production facilities prior to the completion of the filter plant additions, the design of two additional 20-MG reservoirs proceeded simultaneously. The completion of these two reservoirs increased the major storage capacity to 100 MG. Likewise, several steel ground storage units ranging in size from 300,000 to 1.0 MG were erected at various new well sites, and at higher elevations to bolster that part of the system.

Ground was broken for the Squaw Peak expansion in November, 1958, with an allowed construction time of 500 calendar days putting the finishing date in April, 1960, reasonably ahead of our 1960 summer. Fisher Contracting Co. was low bidder on the project at a contract price of \$3,137,700. The contractor, spurred on by an impending rise in materials and labor costs expected sometime in 1959, initiated the work with double shift activity. This pace kept the progress well ahead of schedule.

The summer of 1958 was past, and knowing full well that 1959 would bring an additional 6,600 services from normal growth, City forces concentrated their efforts in bolstering other parts of the water system, keeping one eye on Squaw Peak. Additional wells were drilled. Production capacity of other well installations were increased by changing turbine bowls and impellers, and adding ground storage and booster pumps. Three irrigation wells were even "borrowed" from the Salt River Valley Water Users' Association in an area of rapidly developing subdivisions. With these improvements our 1959 production capacity figured about 175 MGD. A



• SHOWN here is the Sunnyslope-Lincoln Drive pumping station. Capacity is 9½ mgd. Motors are 200 and 300 hp.

highlight of the summer period was the 161-MG day that won a lottery for one of the filter plant shift operators. Troubles and problems in operation were less than the year before, but all this was overshadowed by the onset of a strike of the operating engineers against the construction industry. The furious construction pace came to a halt. By this time there were four different contractors on the site, building a 20-MG reservoir, wash water tank, a pumping station and the filter plant additions. We found some amusement in the fact that our contractors were "color coded." Purely by accident, "hard hats" worn by contractors' personnel came out in four different colors, and even to the uninitiated it was easy to tell a reservoir builder from a pump installer, "without a program."

The strike caused a loss of 55 days and re-established an estimated completion date of June 14, 1960. Realizing that this delay was serious, several conferences were held between the City, the consulting engineer and the contractor. It was mutually agreed that the primary objective was to get the filter plant additions operational as soon as possible.

The month of May found us producing in excess of design capacity at both plants, and on occasions 45 MGD was produced at Squaw Peak alone. This month also witnessed testing of the new 60-MGD additions so that on June 1, 1960, the City put this new portion into actual operation, even though the contract was only 98 percent complete. Seemingly we had met the deadline with success again, but by a mere week.

Although the entire 90-MGD capacity of the Squaw Peak Plant was available, the expansion of transmission capacity was not yet complete. Accordingly, we had provided

personnel and other budgetary items to operate the new 60-MGD section only, and the older section of the plant was idled. An average of 61 MGD was produced at Squaw Peak in June, the biggest day being 73 MG. The raw canal water during this month had less than 200 units of turbidity and the plant inlet, less than 100 units.

Open House Woes

A formal inspection of the new additions by the Mayor, City Council, City Manager and the administrative staff was scheduled for July 6. Whenever time would permit, a little extra "shine" was applied where needed. Coincidentally, a blockage developed in one of the chemical feed lines that ran under the visitors' parking lot, and this had to be dug up and repaired. About this time, late in June, word was received from the Salt River Project, operators of the storage dams on the Salt and Verde Rivers, that the Bartlett reservoir would be emptied for maintenance purposes. Normally this procedure causes higher turbidities in the raw water due to sluicing of the silt but presents no exceptional difficulties that cannot be handled with normal treatment and activated carbon. A careful watch was maintained on the river and on Friday night, July 1, 1960, the turbidities rose so high that the Verde Plant which takes its raw water directly from the rivers, had to be shut down. At this time the effluent of the pre-sedimentation basin showed 5,000 units and values up river a short distance were showing turbidities over 20,000 units. Squaw Peak was showing 1,250 units on July 1. Water travel time down the river and through the canal to the Squaw Peak intake is about 12 hours and on the next day. Saturday, July 2, the mud reached Squaw Peak. When the turbidity of the

plant inlet water reached 4,500 units the original 30-MGD section was cut in with the new units. In the middle of this a 1-in. water line inlet to a lime feeder broke and made a mess of the main operating room, and the central air conditioning unit could not make up its mind whether to work or not.

The water line to the lime feeder that had to be repaired was located in a rather inaccessible place under the floor. This could not be repaired until the plant could be shut down and the raw water inlet channel drained. A garden hose hookup kept the lime feeder in operation and later some temporary piping was put in to cross connect the lime feeder with the alum feeder water source. This was completed and cleaned up by the following Wednesday in time for the open house ceremonies. Squaw Peak treated 78 MG that day, consuming 108,000 lbs. of alum. It goes without saying that the rest of the summer was uneventful except that a lot of water was produced and delivered. Our maximum day in 1960 had a total consumption of 171 MG.

Ordinarily these difficulties could be classed as minor, except for their timing. We think we have had a lot of luck over the past 3½ years. The fact that the nature of the breakdown problems were minor and that they were few in number is significant of the thorough planning, excellent engineering and inspection of construction. Only five change orders were made during the construction with a net addition to the cost of only \$10,274, less than 1/3 of one percent!

The Future

We are adding 7,000 new services per year in our present service area and expect to acquire additional private water companies as annexation continues.



VERDE FILTRATION plant, capacity 30 MGD, is 30 miles from Phoenix, at the confluence of the Verde and Salt Rivers.

As stated above, our present production capacity is 235 MGD. By making some improvements to existing wells, acquiring others and drilling new ones we expect to be on the safe side until 1964. Long range engineering studies based on the water needs of the future population of Phoenix have been made for the year 2000. These studies have estimated that the expanded Phoenix water service area will have 1,146,000 people by 1975 and 1,970,-000 by the year 2000 in a 500-square mile area. By 1964 additional works must be completed so that the production capacity will be increased by an additional 121 MGD in order to meet the consumer demand. Improvements to production, storage and distribution facilities for this are estimated to cost \$30,000,000. Likewise, if the growth prediction continues, another expansion in 1970 of 140 MGD will be required.

The unprecedented growth of Phoenix and the surrounding area has caused others to ask if we have enough water for future use of the population expected to reside in the future Phoenix area. Our engineering studies have determined that there is an assured water supply beyond the year 2000. The big problem is to bring the water to the consuming public to have it available at the tap. From our past experiences, an accurate timetable is as necessary as the funds to do the job.

The additional works to be completed by 1964 include the first increments of two new filtration plants totalling 100 MGD and 60 MG of storage capacity.

Engineering studies for the future began to take shape late in 1959. and it was obvious that at least two large additional filtration plants would be required. Realizing that land values were increasing and that enough land in suitable locations would be harder to find as time went on, the City succeeded in purchasing two separate sites for these purposes. Likewise, a search was made for future reservoir sites and land at the proper elevation was selected and purchased. These purchases were financed from savings out of the current bond issue made possible by many favorable bids on other projects.

Having the land sites is a head start. We hope to get the design for our third filter plant underway soon, before the 1961 bond issue, by utilizing additional savings from present funds. It took over three years to build the Squaw Peak addition—1964 is just that far away.

MAINTENANCE

C. E. ATEN
Engineer of Maintenance,
Wisconsin State Highway Commission

WITH EVER-increasing traffic volumes, particularly in the classes of commercial tandem axle vehicles, and with increasing average age of highways, Wisconsin is necessarily placing increased emphasis on shoulder maintenance. This phase of highway maintenance has been a primary function of our highway maintenance organization ever since shoulders were made part of a highway construction activity. For twenty-five years or more, machinery and methods used in shoulder maintenance have been devised, reviewed, and altered so that the quality of the work is constantly improved to meet demands generated by the traveling public for safe adequate highway shoul-

Current approved design standards on the Wisconsin State Trunk Highway System provide for shoulder surface widths of five, eight, and ten feet on two-lane highways and for ten-foot outside shoulders and six-foot medial shoulders on fourlane divided highways. The design width of shoulders on two-lane highways, which are on the federal aid primary or secondary systems, varies in accordance with design traffic volumes with the upper limit of ten feet being used on all highways carrying a design hour volume in excess of 200. However, many of our older and less heavily traveled highways have never been reconstructed to modern standards and have varying shoulder widths of from two to four feet which are adequate for the volume of traffic using these highways.

With the exception of interstate highways, all highway construction projects include all-weather shoulders with a wearing surface of crushed gravel, crushed rock, or in a few localized areas disintegrated granite. Design standards on the Interstate System in Wisconsin provide for three inches of bituminous concrete surfacing on a gravel or crushed stone base to a width of 7 feet on the outside shoulder and three feet on the medial shoulder.

In general, shoulder aggregate of good quality is available throughout the state at reasonable cost within reasonable haul distance of any highway project. The cost of produced aggregate at the source varies with the difficulties involved in production, such as stripping, blasting, nature of the material, and necessary adjustments to achieve proper gradation. Normally material used in Wisconsin for construction or maintenance of shoulders must meet the requirements for gravel or crushed stone base course as set forth in the Highway Commission's Standard Specifications. Gradation requirements which must be met are shown in Table 1.

When used for shoulder surfacing the upper percentage limit of material passing the No. 200 sieve is increased to 15 per cent to achieve greater binding quality and to compensate somewhat for the expected



 MAINTENANCE on the Wisconsin State Trunk Highway System is done almost entirely by the counties. This shows placement of aggregate during resurfacing.

of State Highway Shoulders



• INTERSTATE design in Wisconsin provides a width of 7 ft. on the outside and 3 ft. on the median shoulder, with 3-in. bituminous concrete on gravel or stone base.

future loss of fines. The fact that this gradation can be met at reasonable cost at practically all locations throughout the state helps considerably to make our shoulder maintenance work less complicated.

The State Trunk Highway System in Wisconsin comprises approximately 11,000 miles of highway of which some 7,000 miles have all weather shoulders with gravel or crushed stone surfacing. The remaining 4,000 miles include about 300 miles of concrete pavement and 3,700 miles of bituminous road mix surfacing on lesser traveled highways which have sod shoulders.

Work Done By Counties

Wisconsin is unique in that the State Trunk Highway System is maintained almost entirely by the individual counties under prearranged agreements with the State Highway Commission. The work is performed under state supervision and in accordance with state-established standards. The counties are reimbursed by the state on an actual cost basis. Under this system the counties must necessarily own all required maintenance equipment and in general each of the 71 counties in Wisconsin is well equipped with the quantity and type of equipment required for proper performance of all maintenance activities. For instance, there are currently available in all

counties a total of 891 motor graders, 320 tow-type graders, and numerous shoulder machines, spreaders, and custom-built drags and planers which can be used in shoulder maintenance operations.

The basic maintenance unit in Wisconsin is a patrol section of 25 to 30 miles in length which is manned by a patrolman and helper equipped with a patrol truck in the 16,000 to 23,000 GVW range and other equipment necessary for the performance of adequate routine maintenance. Shoulder maintenance equipment used by the patrolman is generally one of three types: Small motor grader maintainers; tow-type graders with return blades; and custom-built shoulder drags. While the routine blading and shaping of shoulders is generally done by the patrolmen, more extensive grader work which is sometimes necessary is accomplished with heavier equipment operated by

Table 1—Graduation of Shoulder Maintenance Materials

| S | ieve Sizes | Percent Passing |
|---|------------|-----------------|
| | 1" | 100 |
| | 34" | 85-100 |
| | 36" | 50-80 |
| | No. 4 | 35-65 |
| - | No. 10 | 25-50 |
| 1 | No. 40 | 15-30 |
| P | No. 200 | 3-10 |

other personnel in the county organization.

The frequency of routine blading and shaping of shoulders by the patrolmen is determined primarily by weather and traffic conditions and the width of highway pavement. Through years of experience the time interval between blading operations has become quite stable for specific sections of highway. Twolane pavements 24 feet wide with compacted crushed gravel or rock shoulders require minimum maintenance whereas 20-foot pavements carrying high commercial traffic volumes require blading at least once a week and frequent addition of new material. In general it is our policy to require that shoulder surfacing be maintained flush with the adjacent pavement at all times.

Over a period of time the repeated use of shoulder maintenance equipment often results in the development of a secondary ditch and a build-up of sod near the outside shoulder line. At infrequent intervals, perhaps twice a year, it is necessary to remove this berm with heavy motor grader equipment to provide proper lateral drainage across the shoulder. This operation also helps to bring additional fines into the shoulder aggregate since the berm is carried inward toward the pavement and then floated back to the outer shoulder edge.

Replacing Aggregate

Over the years Wisconsin has experienced the same loss of shoulder aggregate which has been a major problem for maintenance engineers throughout the country. The loss of binder fines in the shoulder surfacing due to normal traffic wear and the "whipping" action of trucks traveling at relatively high speeds is quite significant on an annual basis. The end result over a period of years is usually a condition where the shoulder slope becomes dangerously steep and in his blading operation the patrolman manages to accomplish little except roll loose stone from one side of the shoulder to the other. In general, we require that the patrolmen attempt to forestall the development of this condition by performing blading operations when moisture content in the shoulder material is proper for maximum compaction and by replenishing the lost aggregate through routine replacement with new ma-



SHOULDER maintenance operations on Highway 11, Green
 Co., using motor grader equipped with return blade attachment.



 PULL TYPE grader equipped with return blade working on shoulder maintenance. There are 320 pull-type graders in use.

terfal containing a high percentage of fines. Either commercial aggregates or county produced materials are used.

On some high traffic highways the rate of loss of shoulder aggregate is sufficiently high that the individual patrolman is unable to maintain the shoulders properly through routine blading and spot resurfacing operations. Therefore we have found it necessary to set up shoulder resurfacing projects periodically to restore the shoulders to adequate standards. These projects are either let to private contract or done by county forces, depending upon location of the work, availability of aggregates and the type of equipment owned by the particular

Shoulder resurfacing projects normally require the placement of 200 to 300 cubic yards of new crushed aggregate per mile on each shoulder. Prior to placing the new material we require that the shoulder be shaped by cutting out to a depth of approximately three inches at the pavement edge and wasting this loose material near the outer edge of the shoulder. This operation is generally performed by a motor grader and permits the placement of new material to a sufficient depth to secure good compaction in the critical area adjacent to the pavement. We also require that the added material be placed by a shouldering machine to secure uniformity. Watering and rolling are required as necessary to achieve the proper compaction and density. This type of resurfacing operation must be repeated about once every ten years on heavy traffic roads and considerably less often on secondary highways carrying low volumes of traf-

Another method for minimizing aggregate loss is shoulder stabiliza-

tion. The bituminous concrete surface on our interstate shoulders naturally provides the maximum stabilizing effect; however, it is an obvious economic impossibility to place such high type surfacing on all shoulders and therefore other stabilizing media must be used. In recent years we have set up a number of experimental shoulder stabilization projects using a variety of materials and methods, including calcium chloride, sodium chloride, bituminous penetration, and sulphite liquor, which is a waste product of the paper industry in Wisconsin. In addition, a construction project was set up in 1959 to stabilize the loose sand shoulders on a specific section of one highway using a soil cement method.

Most of the experimental jobs involve scarifying and mixing of the shoulder aggregate with the stabilizing material to a depth of at least three inches and generally for the full width of shoulder, although some surface treatment with calcium chloride was and is being used in particularly critical areas. Space does not permit detailed descriptions of the various stabilization experiments but our experience to date and our cost analyses in general would indicate that anything more than occasional surface treatment of the strip immediately adjacent to the pavement cannot be justified economically.

In lieu of full width stabilization in depth we have recently adopted as part of our shoulder maintenance program a method of spot correction of serious "rutting" in critical areas with crushed aggregate premixed with calcium chloride. These critical areas include the insides of curves, intersections involving considerable turning movements, and similar locations where shoulder rutting next to the pavement is a

serious problem. In this operation the patrolman cleans off all the stone, widens the rut to approximately one to two feet, then places and compacts the premixed gravel and chloride in the resulting trench. This method has proved to be quite satisfactory and has considerably reduced the need for frequent blading operations to bring the shoulders flush with the pavement.

Wisconsin's annual expenditure for shoulder maintenance at the present time averages about \$1,050,-000 or approximately \$95 per mile of state trunk highway. This cost covers all phases of shoulder maintenance work, including routine blading operations, resurfacing, erosion repair on shoulder slopes, and in some instances sweeping shoulder gravel off intersections. Routine blading operations involve an annual expenditure of about \$85 per mile based on the approximately 7,000 miles of all-weather surfaced shoulders which require blading. Major resurfacing projects are set up on about 130 miles of state highway each year at an average cost of approximately \$1,100 per mile. The average rate of application of base course material on shoulder resurfacing projects is about 500 cubic yards per mile at an average cost of \$2.10 per cubic yard in place on the shoulder. Here again Wisconsin's good fortune in having numerous available deposits of quality aggregate permits us to undertake considerable work of this nature at an economical cost.

We in Wisconsin feel that we have a well balanced shoulder maintenance program which provides, at least on a greater part of our State Trunk Highway System, a safe stable surface for any motorist who must leave the pavement and use the shoulder for emergency or other purposes.

AERATION TANK HAZARDS REDUCED BY SAFETY CABLE

SINCE the Hamilton, Ohio, sewage treatment plant has been in operation, we have been very much aware of the danger involved in working in the area of the aeration tanks. At least four people have lost their lives from such hazards in Ohio during the past year.

Each of three aeration tanks in the Hamilton activated sludge treatment plant is divided into two parallel chambers. Between the chambers are six-foot walkways to provide access to the aeration equipment. In addition, four walkways provide access to the final effluent spray system for froth control and three walkways, access to the swing mechanism supporting the aeration diffusers. The operating and maintenance personnel are often required to use these walkways in cleaning the spray nozzles and diffusers and in hosing the scum resulting from froth formation. In the winter, the walkways become covered with ice, a condition aggravated by the use of sprays. The hazards in the area are augmented by the sense of instability which may affect a person while watching the rolling liquid in the aeration tanks for a period of

The usual type of guard rail did not appear to be feasible due to interference when operating the swing diffusers and guard rails would be quite costly to install. After many months of study and discussion by all plant personnel, it was decided that a steel cable supported eight H. W. AUGENSTEIN
Supt., Water and Sewage Treatment
Hamilton, Ohio

feet above the center of each walk-way for the entire length of the aeration tanks would be most practical and of low cost. Light weight safety belts made of nylon webbing were purchased. Hand lines made of manila rope with safety hooks attached to each end were used to connect the safety belts worn by the personnel to the suspended cable. The hand lines are long enough to permit freedom of movement while working on the walkways but not long enough to permit complete



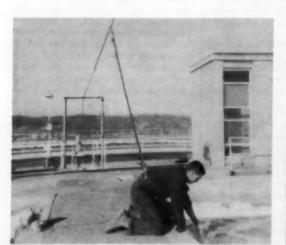
 SAFETY belts and steel cables were used to reduce hazards to the operators.

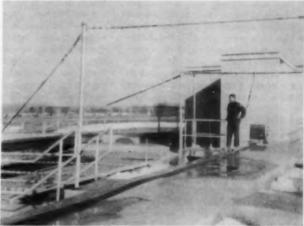
submergence if the employee should accidentally fall into the tank.

The cable used for the project was ¼-in. galvanized steel strand composed of seven twisted wires. The cable has a breaking strength of 2500 lbs. and is used in the Electrical Distribution Department for guying poles. Each span is approximately 150 ft. long supported only at each end. At the edge of each outside wall, a single 2-in. galvanized pipe was erected and embedded approximately three feet in the ground. These supports were placed in concrete and guved with an electric pole anchor placed about eight feet below ground level. The same cable was used for the guy as was used for the span.

The supports on the opposite ends of the spans were two vertical 2-in. pipes, joined at the top with a cross pipe by means of galvanized ells. The cable end was attached to the middle of the cross pipe with an eye bolt and the supports guyed to the adjacent steel structure. The vertical pipes were bolted to existing guard rails in the vicinity of the final tanks. Turnbuckles were used on one end of each cable to maintain a taut cable. The top ends of the single supports were capped.

The total cost was \$695.55, of which \$300 was for labor; \$175.84 for the galvanized pipe; \$65.80 for safety belts; \$56.20 for cable; \$41.97 for bolt clamps and turnbuckles; \$41.84 for anchors, anchor rods and accessories; and \$13.90 for concrete.





TAKING a sample of mixed liquor from the aeration tank using the safety belt and cable. Right, types of cable supports.

BASIC PRINCIPLES OF PAVEMENT DESIGN

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Part 2 - Rigid Pavements

In Part I of this article two broad aspects of pavement design were considered: 1) Evaluation of pavement performance and establishment of criteria to fit a given set of conditions; and 2) a thorough understanding of the basic principles of pavement behavior under load. In developing these design aspects, consideration was given to pavement types, pavement distress, techniques of measuring defects and the serviceability concepts or rating techniques used to evaluate pavement performance. Methods of analyzing traffic and traffic effects on design requirements were covered. The critical results of frost action were correlated with the freezing index developed from an accumulative plot of degree days and the important aspects of subdrainage were discussed. With this background of consideration of design problems, Part II presents the basic design principles applicable to rigid pavements. Flexible pavements will be discussed in Part III, to appear in the May issue.

The material in this series of articles is based in part on the book by the author, *Principles of Pavement Design*, published by John Wiley and Sons, Inc., New York, 1959.

A RIGID PAVEMENT consists of a relatively thin concrete slab poured on the subgrade or a base course. The load carrying capacity of the pavement-base-subgrade structure is brought about largely by "beam action" of the pavement.

Base courses are used under rigid pavements for a variety of reasons including control of pumping, frost action, drainage, and structural improvement. Nevertheless, theoretical considerations and field performance have demonstrated that so long as the first three of the above factors are accounted for, the base adds little to the structural capacity of the pavement-base-subgrade structure.

Since the concrete slab is the major component of the structure, stresses in concrete pavements have been given detailed consideration by many investigators (11). Stresses in rigid pavements can result from several causes including volumetric changes in the subgrade and/or subbase, restrained temperature

movements, changes in moisture, and wheel loads.

Each factor listed above can cause stresses to occur in the slab which are sufficient to result in cracking. The stress inducing factors are extremely complex and in order to evaluate them mathematically, it is necessary to make several simplifying assumptions.

Loss of subgrade contact can also cause stresses which might exceed the modulus of rupture. Discontinuity of contact between the pavement and subbase or subgrade may result from pumping, plastic deformation of the subgrade, and warping or curling resulting from temperature gradient through the slab.

In addition to the above, durability characteristics of the concrete may have a pronounced effect. Non-durable aggregates may cause extensive deterioration of the concrete. Scaling which results from the use of salts for ice removal is still another form of deterioration.

It is desirable, in most cases, to use joints of various types in rigid pavements. These, however, may also present problems in the form of frozen dowel bars, improper dowel alignment, etc.

Pavement distress may result from any of these or a combination of one or more factors. As an example, consider a pavement with a temperature gradient, wherein the top of the slab is cooler than the bottom. Under this condition, the corners of the slab will tend to warp upward. The weight of the slab will then cause tension in the upper fibers and compression in the lower fibers. A load placed at the corner will cause stresses which add to the warping stresses. Thus, even though the warping stresses or loading stresses themselves may not cause cracks to develop, a combination of load and warping stresses may do so. Loss of subgrade contact resulting from pumping will aggravate the situation.

Due to the complexity of stress inducing factors, many highway engineers have adopted standard designs which vary only with amount of traffic. Hence, the thickness of rigid highway pavements, except in rare cases, is an arbitrary value determined from field performance of prototype and test pavements. Also, the type and thickness of base courses vary from one locality to another, depending upon performance and availability of materials.

Most airport pavements are designed using the theoretical considerations of Westergaard modified with appropriate factors of safety. Subsequent paragraphs in this article will summarize the factors affecting pavement performance and will present design concepts currently in use by engineers. Detailed theoretical considerations are obviously beyond the scope of this article and will not be presented herein.

Figure 20 shows a typical reinforced highway pavement. Longitudinal joints for control of warping and contraction are generally used. These are usually tied with steel bars to hold the joint tightly closed. Transverse joints include expansion, contraction, and construction types. The type and spacing of joint used varies from state to state.

Airport pavements are similar to the pavement shown in Figure 20 with several major exceptions. First, airport pavements are considerably wider than highway pavements, necessitating additional longitudinal joints. Tie bars are generally used only on outside lanes, since the outside lanes restrain the movement of interior slabs. Second, airport pavements are generally thicker than highway pavements because of high loads applied to them. Third, distributed temperature steel is often omitted on airport pavements. Subsequent paragraphs of this article will contain a discussion of the design of reinforcing steel.

fiber stress under the breaking load. The value is determined by means of the flexural equation.

$$s = \frac{Mc}{I} \quad . \quad . \quad (5)$$

The modulus of rupture as determined by Equation 5 is not strictly correct, since it applies only within the elastic range of the concrete. Also, values of modulus of rupture vary to some extent with the size of the beam and the method of applying the load. Whenever possible, standard procedures should be used. It is common practice to use about 110 percent of the 28-day modulus in the thickness calculations.

in the

The performance of pavements is greatly affected by the characteristics of the subgrade. (12).

Subgrade Effects

Desirable properties which a subgrade should possess include strength, drainage, ease of compaction, permanence of compaction and permanence of strength. Since subgrades vary considerably, it is necessary to make a thorough study of the soils in place and from this to determine the design of the pavement. Soil is a highly variable

FUNDAMENTAL CONSIDERATIONS

Relative Stiffness

A rigid slab built over yielding ground will deflect as a result of a load applied to it, as well as from warping and curling. The magnitude of stress is a function of the radius of curvature of the slab after bending.

As a slab deflects, it induces reactive pressures between the slab and supporting medium. It is commonly assumed that the amount of reactive pressure bears a direct lineal relationship to the magnitude of deflection. The degree of resistance offered by the subgrade depends upon its stress-strain properties.

According to the theory of elasticity, the relative stiffness of a continuous member can be expressed as follows:

$$D = \frac{Eh^3}{12(1-\mu^2)} . . . (3)$$

Westergaard has proposed a quantity which expresses the relative stiffness of slab and foundation. This is termed the radius of relative stiffness.

$$l = \sqrt[4]{\frac{D}{k}} . . . (4)$$

In Equations 3 and 4, h is the thickness of slab, E its modulus of elasticity, μ its Poisson's Ratio, and k the modulus of subgrade reaction. The relative stiffness D is analogous to the EI term used in structural analysis. The radius of relative stiffness has a lineal dimension (inches) and cannot be considered to have direct physical significance regarding radius of load influence through the slab. The radius of rel-

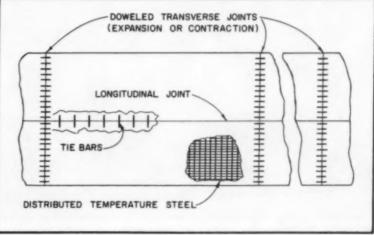
ative stiffness appears in all mathematical expressions dealing with stresses in rigid pavements. Values of radii of relative stiffness for the usual conditions found on highways are shown in Table 6.

Modulus of Rupture

The allowable stress in rigid pavements is determined by beambreaking tests. The modulus of rupture then is taken as the extreme

Table 6-Radius of Relative Stiffness

| | (E | = 4,000,000 | psi u = | 0.15) | | |
|-----------------------|--------|-------------|---------|---------|---------|---------|
| Slab Thickness (ins.) | k = 50 | k = 100 | k = 150 | k = 200 | k = 300 | k = 400 |
| 6.0 | 34.84 | 29.30 | 26.47 | 24.63 | 22.26 | 20.72 |
| 6.5 | 36.99 | 31.11 | 28.11 | 26.16 | 23.64 | 22.00 |
| 7.0 | 39.11 | 32.89 | 29.72 | 27.65 | 24.99 | 23.25 |
| 7.5 | 41.19 | 34.63 | 31.29 | 29.12 | 26.32 | 24.49 |
| 8.0 | 43.23 | 36.35 | 32.85 | 30.57 | 27.62 | 25.70 |
| 8.5 | 45.24 | 38.04 | 34.37 | 31.99 | 28.91 | 26.90 |
| 9.0 | 47.22 | 39.71 | 35.88 | 33.39 | 30.17 | 28.08 |
| 9.5 | 49.17 | 41.35 | 37.36 | 34.77 | 31.42 | 29.24 |
| 10.0 | 51.10 | 42.97 | 38.83 | 36.14 | 32.65 | 30.39 |



• FIGURE 20. A typical rigid highway pavement showing the reinforcement used.

material; the inter-relationship of soil texture, density, moisture content and strength are complex, and in particular, behavior under repeated loads is difficult to evaluate. As a result, it is not possible to set down rules which will be suitable for all cases. Nevertheless, it is possible to formulate techniques and procedures which will give satisfactory results if the principles involved in design of the subgrade are readily understood by the design engineer.

It will not be the purpose here to discuss in detail the subject of soil mechanics. Much has been written during recent years on this subject and it is possible to find many articles and text books which deal with the subject in great detail. However, several points are worthy of discussion in light of the great influence of subgrades on pavement

The science of pedology deals with the weathering processes of soil and the formation of soil profiles. The primary climatic agencies affecting formation of profiles are amount of surface runoff and temperature. A soil profile is the result of natural weathering which alters the parent soil. The typical soil profile as applied to Civil Engineering consists of three layers or horizons. These are visible in Figure 21.

performance.

The lower horizon designated parent material or C horizon con-

sists of the original unweathered soil. The parent material can be either transported or residual. The A and B horizons constitute the weathered zones. Horizons as described above are a simplification since pedology designates many more sub-divisions. The sub-divisions, however, represent transition zones of little consequence to highway and airport work.

In general terms, the uppermost or A horizon is principally a silty material whereas the B horizon is generally clay-like. Therefore, it is apparent that the effect of subgrade on pavement performance depends upon the relative vertical position of the pavement within the soil

It is beyond the scope of this series of articles to include a detailed description of soil areas and their effect on design. Nevertheless, the engineer should realize that a knowledge of the aerial concept of soil formation is essential. Before an adequate soil exploration program can be planned, it is necessary to study in detail the geology of the area so that the subsurface conditions can be anticipated. In this way an economical exploration and design program can be formulated and carried out with the least expenditure of time and money.

SOIL CLASSIFICATION

Three methods of classification are in common use in highway and airport work. These are the Highway Research Board (or AASHO) soil classification system, the Federal Aviation Agency system and the Unified soil classification system. Details of these classifications are not presented herein due to space limitations (13). Soil classification is a means to an end. Mere classification by itself will not yield sufficient information to permit an accurate prediction of true behavior.

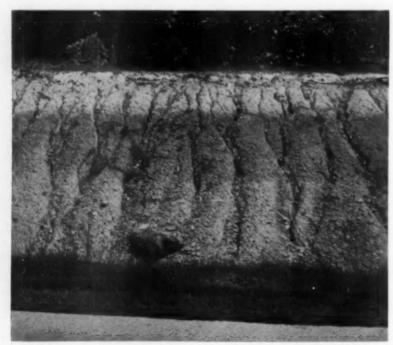
However, soil classification serves a useful purpose and should be carried out as a routine manner. It will permit an estimate of the behavior of the soil and it serves as a tool for grouping the soils which are encountered.

As a rule, time will not permit tests to be made on each sample of soil encountered in the sampling program. Therefore, it becomes necessary to classify visually a large number of samples. An experienced person can, after he is familiar with the classification system, assign classification symbols to soils by judging their appearance and texture. In so doing the number of tests required for classification purposes can be kept to a minimum.

Visual classification, however, should be done only by an experienced person. Selection of samples for routine tests should be made taking into account profile development and sequence of soil layers. Random selection of samples is never justified and can easily give misleading results.

Soil Borings

The first step that must be accomplished before the subgrade can be designed is to investigate the lateral and vertical extent of all soils which will underlie the pavement. The investigation can be accomplished by first making a reconnaissance survey of soil conditions in cuts and other exposures and then determining the type of soil by detailed exploration. Techniques utilizing geology and pedology or aerial photographs are particularly well adapted for this purpose.



● FIGURE 21. Disregarding erosion, the three typical soil profile horizons are readily seen as alternating dark and light strata on the face of this cut section.

Auger borings are usually spaced at 200 to 300 foot intervals and drilled to a depth at least ten feet below finished grade. Natural moisture content and plasticity tests should be made on all representative samples so that soil profiles along the centerline of the pavement can be plotted to assist the engineer in determining design values that he should use. Since it is not possible to test in detail all the soils encountered, it is essential that the engineer rely heavily upon the principles of soil formation. The exploration program can be accomplished with a minimum amount of effort if the fundamentals of soil horizon development and the concept of parent material areas are understood.

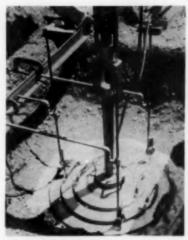
Soil Strength

Many tests have been devised for measuring the strength properties of soils. Insofar as design of pavements is concerned, the tests by and large are arbitrary and their usefulness lies in the correlation of the test results with field performance. As a result, many of the procedures for testing soils have been standardized; the procedures must be followed at all times in order to obtain reproducible results.

Each test currently available has its advantage, but also its disadvantage. Therefore, definite rules cannot be set down for determining the type of test to be made, particularly, since pavement design procedures are generally based upon a correlation of the test values with field performance. Perhaps the three most widely used tests for design are the California Bearing Ratio Test, the Plate-Loading Test and the Hveem Stabilometer Test. Equipment used in performance of the plate test is illustrated in Figure 22. It should be realized that testing of this type is highly specialized and should be carried out only by competent laboratory tech-

Regardless of the type of test which is made, the fundamental underlying assumption of all tests is that the soils are tested in the condition at which they are anticipated to exist in the prototype pavement. Thus it has become standard practice to attempt saturation of laboratory samples before making strength tests.

Referring to Figure 22 the plate loading test is one made to evaluate the supporting power of subgrades, bases and in some cases completed pavements by utilizing relatively large diameter plates. Data from the



• FIGURE 22. Plate bearing test showing plates and dial indicators.

tests are applicable to the design of both flexible and rigid pavements. Although the testing procedure, methods of analysis and application of the results in design differ for rigid and flexible pavements, the basic testing procedures are similar in both cases.

Circular plates are used. The reaction for the load may be supplied by heavy mobile equipment tied to a steel beam. The load is applied to the plates by means of hydraulic jacks. Deflection of the plate is measured by means of deflection dials placed usually at the one-third points of the plate near its outer edge. To minimize bending, a series of stacked plates should be used. For 30-inch bearing plates, 24, 18 and 12-inch plates are usually stacked on the large plate, the load being applied to the 12-inch plate.

The unit load which a plate will sustain depends on the perimeterover-area ratio as well as the strength of the soil. The unit load which the plate will sustain at a given deflection is given by Equation 6.

$$s = n + m \frac{P}{A} \quad . \quad . \quad (6)$$

where

s =settlement of the plate n, m =constants which depend on soil type

P = perimeter of the plate A = area of the plate

This formula is based on empirical relationships and is accurate for soils that do not follow the elastic theory. To determine the values of m and n, tests must be made on each soil with at least two different sizes of bearing plate using the same deflection.

Since the unit load the plate will sustain depends on the size of the plate, it is desirable to use standard size plates. Plates 30 inches in diameter are most widely used. For flexible pavement design, however, plates equal in area to that of the contact area of the tire are generally used.

Two important properties of the soil can be measured by means of the plate loading tests. These are modulus of elasticity and modulus of subgrade reaction. The first of these quantities is used in the design of flexible pavements and the latter for the design of rigid pavements.

The modulus of subgrade reaction can be expressed as follows:

$$k = \frac{p}{\Delta} \quad . \quad . \quad (7)$$

where

k is the modulus of subgrade reaction, pci

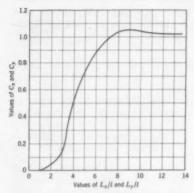
p is the unit load on the plate, psi Δ is the plate deflection, inches

PAVEMENT STRESSES

Previous paragraphs have indicated that stresses may exist in rigid pavements as a result of several factors. These include restrained volume changes, loss of subgrade contact and load. It must be recognized that cracking and potential failure of a rigid pavement can result from any of the factors listed above or by a combination.

Warping

If a pavement slab is subjected to a temperature gradient through its depth, the surface will tend to warp. The tendency to warp is restrained by the weight of the slab itself. Dr. Westergaard has developed equations for three cases of warping. For case one, the slab is assumed to be infinite in both the x and y directions. For case two, the slab is assumed to be infinite in the plus y and the plus or minus x direction. For case three, the slab is assumed to be infinite for both the plus or minus x, with a finite width. Westergaard's equations were used by



From Principles of Pavement Design by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1959

• FIGURE 23. Warping stress coefficients used in Equations 8 and 9.

Bradbury (14) to develop coefficients for a solution of the problem. These coefficients are shown in Figure 23 and are used in the following equations.

Edge stress:

$$\sigma = \frac{C E \epsilon_t}{2} \Delta t \quad . \quad . \quad (8)$$

Interior stress:

$$\sigma = \frac{E \epsilon_t \Delta_t}{2} \left(\frac{C_1 + \mu C_2}{1 - \mu^2} \right) . \quad (9)$$

The coefficient C_1 is in the desired direction, whereas C_2 is for the direction perpendicular to this direction; L_x and L_y are the free length and width respectively.

Tests have shown the maximum temperature differentials occurring during the day in the spring and summer months. During the spring, the subgrade is cool and the slab, which is exposed to the sun, warms faster than the subgrade. During the summer months, the slab cools during the night-time and its top becomes warm during the daytime. Maximum temperature differentials for slabs 6 and 9 inches thick approach 2.5 to 3.0 degrees F. per inch of slab.

Expansion and Contraction

Stresses can also be built in rigid pavements from uniform temperature changes which cause the slab to contract or expand. If a slab cools uniformly, a crack will generally occur at about the center of the slab. Shrinkage of the concrete also causes cracks to form. Excessive expansion may cause "blowups" to occur.

If a slab were free to move (no friction between the slab and sub-

grade), stresses would not result from contraction; however, friction exists between the slab and subgrade and restraint results from the friction forces. Likewise, during uniform expansion, the movement is restrained by friction between the slab and subgrade, as well as the compression in the concrete itself. If relatively long slabs are used, cracking is almost inevitable as a result of warping and/or contraction. Therefore, the usual procedure adopted for design is to provide distributed steel throughout the length of long slabs to hold the cracks tightly closed so that load transfer will be provided by grain interlock. It should be recognized that this distributed steel is not intended to add to the structural capacity of the slab, but merely to

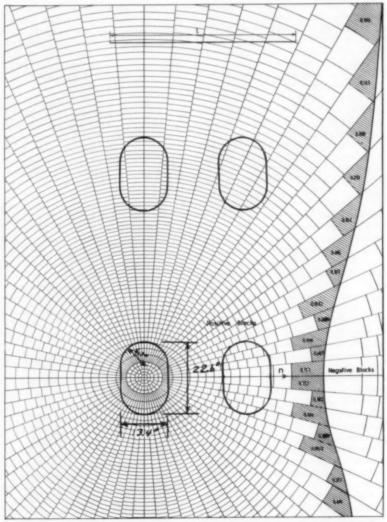
control crack width, so that loads can be transferred across any cracks that develop.

Stresses at Joints

Stresses can also be set up at rigid pavement joints, resulting from infiltration of foreign matter into the joint. Sandy material from the shoulder, cinders and sand used for ice control, and other debris can filter down into the joints during the contraction cycle, particularly at expansion joints. After expansion, exceedingly high compressive stresses may act on the slab.

Loading Stresses

The equations for stresses in rigid pavements resulting from load are quite complicated, and will not be presented herein. These equations



From Principles of Pavement Design by E. J. Yoder, published by John Wiley & Sons. Inc., New York, 1939 (From Pickett and Ray, Transactions, A.S.C.E., 1951.)

FIGURE 24. Influence chart for moment in a concrete slab, interior load case.

are based upon theory of elasticity, and include values for Poisson's ratio, modulus of subgrade reaction, size of a loaded area, and depth of the concrete slab. The solution of the stress equations is time consuming because of the large number of variables which are present. Pickett and Ray (11) have developed influence charts for the solution of the general equations. Figure 24 shows an influence chart for moment in a concrete slab for an interior load case. The tire imprint is traced on the influence chart and the number of blocks within the imprint area are counted and equations 10 and 11 are used for solution of the stresses.

$$M = \frac{p \; l^2 N}{10,000} \; . \quad . \quad (10)$$

$$s = \frac{6M}{h^2} \quad . \quad . \quad (11)$$

where

p = contact pressure

l = radius of relative stiffness

N = number of enclosed blocks on Figure 24

h = pavement thickness

Figure 25 shows the relative effects of gross load and modulus of subgrade reaction on stresses in a rigid slab. Substantial savings in pavement can be realized by utilizing dual wheels for a given wheel load. Increasing the tire pressures results in higher pavement stresses, thus requiring thicker pavements. High pressure tires result in high stress concentrations because of decreased radius of curvature.

In Figure 25 it is seen that for the 60 kip single wheel, increasing the modulus of subgrade reaction from 50 to 300 pci permits just 1½ inches reduction in pavement thickness.

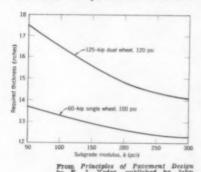


FIGURE 25. Effect of subgrade modulus on required pavement thickness for the interior load case and a working concrete stress of 380 psi.



• FIGURE 26a. Active subgrade pumping ejects muddy water from pavement joint.

However, the reduction is more than 3 inches for the 125 kip load; thus, the modulus of subgrade reaction has more effect on the required thickness for high loads than it does for light loads. For very light loads, the effect of k upon thickness is often negligible.

Theoretical considerations, as well as field performance, have indicated that so long as pumping, frost action and drainage are controlled, subgrade type has a minor effect upon required rigid highway pavement thickness. This does not mean, however, that subgrade has no effect on required thickness, but rather that so long as these other factors are controlled, the effect of subgrade type may in some cases be minimized. Thus, use of granular base courses to improve structural capacity is often uneconomical. Base courses, however, are generally used under rigid pavements to control pumping, frost action, and drainage, and to provide a uniform layer upon which to build a pavement structure.

Pavement Pumping

Pumping of rigid pavements was recognized as a serious problem during the late years of the Second World War. As a result, field studies were made by many state highway departments to determine the cause and extent of pumping. Briefly stated, pumping is the ejection of water and/or subgrade or subbase material through joints, cracks, and along the edges of the pavement. This is caused by the downward movement of the slab actuated by heavy loads over the pavement after the accumulation of free water on the subbase or subgrade. Much



• FIGURE 26b. Subbase pumping.

has been written relative to the cause and effect of pumping (15). Figure 26 shows pictures of active subgrade and subbase pumping.

The initial step in pumping is the creation of a void space under the pavement where free water may accumulate after repeated loads are applied to the pavement. The void space may be small and discontinuous and can be caused by two principal factors. First, loads imposed on the pavement may create a small space between the underlying soil or base course and pavement due to plastic deformation of the underlying strata after the more elastic slab rebounds. Warping of the slab due to temperature differential within the slab will also create a small space under the pavement. Next, water may enter this space and, unless the soil is free draining, the water will be ejected from under the pavement under subsequent deflection of the slab. Through many deflections of the slab, the pumping may continue until a relatively large void space

is created. Then the slab may crack and settle causing a very rough payement.

Pumping of subgrades is primarily associated with plastic, fine-grained soils; however, pumping has been found in areas where the soils are only moderately plastic. Pump susceptibility of soils ranges in the same order as that given by most classification systems. That is, the most susceptible are the clays with high plasticity. The least susceptible are the granular materials.

Design procedures which can be

adopted to minimize pumping are first, the use of good subbase course materials, and second, proper consideration for design of an adequate pavement slab. Structural capacity of the pavement has a large effect on pumping, in that pumping is most noticed at expansion joints and on pavements which are overloaded. The use of well drained, clean subbases will effectively control pumping. If poorly graded subbases containing an excess of fines are used, pavement distress may result from pumping of the subbase material.

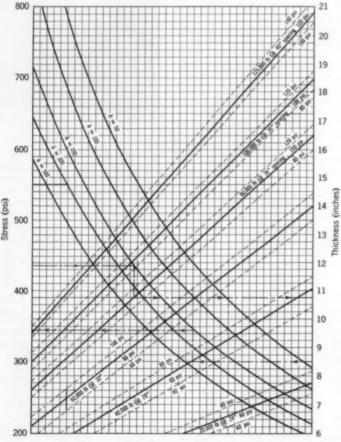
STRUCTURAL DESIGN

Structural design of rigid pavements is accomplished in several ways that can be categorized as follows:

 Theoretical stress analysis, modified by appropriate factors of safety. 2) Soil classification.

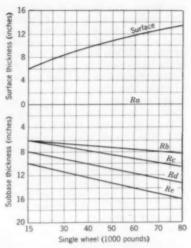
Rule of thumb, based entirely upon past experiences.

Design techniques adopted by the Corps of Engineers and the Navy Department are based upon theoretical stress analysis. The Federal



From Principles of Pavement Design by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1959 (Courtest Portland Cement Association)

FIGURE 27. Rigid pavement design curves, dual wheels, interior load.



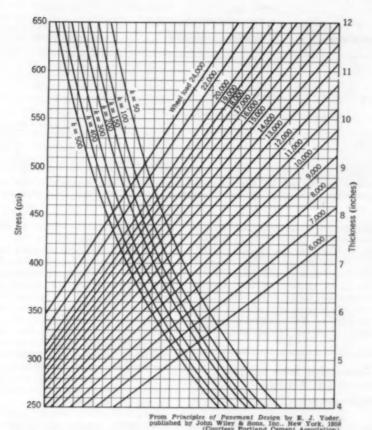
From Principles of Pavement Design by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1969

FIGURE 28. F.A.A. rigid pavement design curves for taxiways and runway ends. Reduce the thickness of concrete to 80 percent of these values for non-critical areas.

Aviation Agency has adopted a method of design for airport pavements based upon soil and climatic classification. Most highway pavements are built to arbitrary thicknesses determined entirely upon the basis of past experiences.

Figures 27, 28, and 29 indicate design curves which can be used for determining the thickness of airport and highway pavements. Table 7 indicates the Federal Aviation Agency classification method which is used in conjunction with Figure 28. These design charts are applicable to specific loading cases; charts for other loading conditions can be found in published literature (16).

The factor of safety which should be applied to the modulus of rupture when designing an airfield pavement depends upon the type of feature. According to data presented in the first part of this series of articles, the magnitude of stress on rigid airfield pavements depends upon repetition of load, gear configuration, gross load, tire pressures, and type of feature (taxiways, runways, etc.). Slow moving loads cause more distress than faster moving loads, and thus, taxiways and runway ends are designed for greater load carrying capacity than lesser used features. Factors of safety generally used are as follows: For aprons, taxiways, hard standings, runway ends and hangar floors, 1.7 to 2.0; for runways (that is, the central portion) 1.25 to 1.5. Design



• FIGURE 29. Rigid pavement design chart, protected corners, dual wheels.

procedures set up by the Corps of Engineers are for the edge loading case, whereas the design chart shown in Figure 27 is for the interior load. Factors of safety adopted by the Corps of Engineers vary

somewhat from those listed above because of geometric layout considerations which are predicated on a channelized traffic concept.

To use the FAA method of design, it is first necessary to classify the

soil on the basis of physical test results. Next, values for drainage and frost conditions are assigned to the soil classification, depending upon the conditions which will exist at the airfield. A no-frost condition exists when frost penetration is less than the thickness of the pavement. A severe frost condition exists when the depth to anticipated frost is greater than the design thickness of the pavement. Poor drainage implies a qualitative measure of the drainage conditions at the site which takes into account subsurface as well as surface drainage. Good drainage results when excellent surface runoff conditions, as well as good internal drainage characteristics such as might be expected for granular soils, are encountered.

Considering the Portland Cement Association design curves for rigid highway pavements, the design is predicated upon a relationship between the number of stress repetitions to induce fatigue failure and safety factors. In this analysis the controlling wheel load (design load) is taken to be the average of the heaviest 100,000 anticipated wheel loads that will use the traffic lane throughout the pavement life. As a result, the design wheel load is often considerably higher than the maximum wheel load permitted by law in the various states.

It must be emphasized that use of the design charts shown in Figures 27, 28, and 29, in itself does not necessarily imply adequate design. Many factors must be considered before design is attempted. These include external conditions

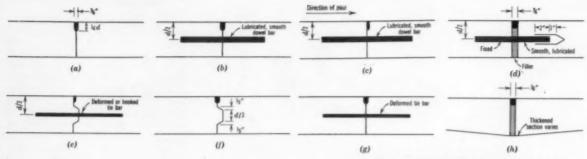
Table 7—Federal Aviation Agency Subgrade Classification For Rigid Pavement Design

| Soil Group | Retained Pass on No. 10 | | | Pass No. 270 Sieve (%) | Liquid Limit | Plas- ticity Index | Subgrade Class | | | |
|---|--|--|---|--|--|--|--|---|--|--|
| | No. 10 Sievet (%) | Ret. Ret. No. 60 No. 270 (%) (%) | Good No Frost | | | | Drainage Severe Frost | Poor No Frost | Drainage Severe Frost | |
| E-1 E-2 E-4 E-6 E-7 E-8 E-9 E-11 E-12 E-13 | 0-45 0-45 0-45 0-45 0-55 0-55 0-55 0-55 | 40+ 15+ | 60- 85- - - - - - - - - - - - - - - - - - | 15- 25- 25- 35- 45- 45+ 45+ 45+ 45+ 45+ 45+ examination | 25- 25- 25- 35- 40- 40- 50- 60- 40+ 70- 80- 80+ | 6- 6- 10- 15- 10- 10-30 15-40 30- 20-50 30+ | Ra Ra Ra Ra Rb Rb Rb Rc Rc Rd Rd Not su | Ra Ra Ra Rb Rb Rb Rc Rc Rc Rc Rd Rw itable for subs | Ra Ra Rb Rb Rb Rc Rc Rc Rd Rd rade | Ra Ra Rb Rb Rc Rd Rd Rd Rd Re Re |

NOTES

Classification is based on sieve analysis of the portion of the sample passing the No. 10 sieve. When a sample contains material coarser than the No. 10 sieve in amounts equal to or greater than the maximum limit shown in the table, a raise in classification may be allowed provided the coarse material is reasonably sound and fairly well graded.

The soil components in the mechanical analysis are designated as: Coarse Sand—passing No. 10 sieve, retained on No. 60; Fine Sand—passing No. 60 sieve, retained on No. 270; Silt and Clay—passing No. 270 sieve.



From Principles of Pavement Design by E. J. Yoder

• FIGURE 30. Typical joints. (a) Dummy-groove contraction; (b) dummy-grooved doweled; (c) butt construction; (d) expansion; (e) keyed longitudinal, tied; (f) keyed hinge or warping; (g) tied longitudinal warping; (h) longitudinal expansion.

of drainage and climate, availability of construction materials, construction techniques, permissible roughness of the pavement and many others.

Joints and Load Transfer

Rigid pavements are subjected to internal stress conditions created by volume changes resulting from changes in temperature and moisture content in the concrete. Stresses in rigid slabs also can be a result of volume changes in the underlying base course and subgrade. It should be understood that stresses caused by temperature and moisture changes in concrete are independent of the externally applied load. However, these stresses in

some cases must be added to the stresses caused by load.

One method of counteracting the stresses that exist in a slab is to build into the pavement transverse and longitudinal joints spaced in such a manner as to relieve the stresses. It is significant to note that a joint is a "designed" crack placed in the slab at a strategic location. By placing joints at predetermined locations, rather than permitting uncontrolled cracks to develop, it is possible to provide load transfer devices at the joints, thus minimizing the effects of loads.

Figure 30 shows several typical joints which can be used. Contraction joints are intended to relieve only tensile stresses. In some cases, load transfer from grain interlock will be questioned, and thus, a dowel bar is placed across the joint. These dummy groove joints may be formed by sawing, or may be formed by placing a metal, plastic or fiber strip into the uncured concrete and then removing the strip as soon as the initial set of the concrete has taken place.

Expansion joints must be constructed with a clean break throughout the depth of the slab to permit expansion to take place. The clear distance across the joint is usually maintained at about ¾ inch although in some cases it may be desirable to permit a one-inch opening.

Since the joint has no aggregate interlock, it is necessary to provide some type of load transfer. This is best accomplished by means of dowel bars which must be smooth and lubricated on at least one side. An expansion cap must also be provided to allow space for the dowel bar to move during the ex-

pansion process.

Construction joints are usually of the butt type and contain dowel bars for transferring the load

Table 8—Typical Transverse Contraction Joint Spacing and Dowel Bar Requirements For Airports

DOWEL-BAR SIZE REQUIREMENTS

| Agency | Slab Thickness (in.) | Diameter Dowel (in.) | Length (in.) | Space (in.) | Type Dowel |
|-----------------------|-------------------------------|----------------------------|--|----------------------------|--|
| FAA | 6-7 8-10 11-15 16-20 | 1 1 11/4 1 11/2 | 16 16 20 24 | 12 12 15 15 | |
| Corps of Engineers | Less than 8 8-11 12-15 | 3/4 1 11/4 | 16 16 20 20 20 20 24 24 30 | 12 12 15 15 18 | % in. round 1 in. round 1¼ in. round 1 in. ex. strong pipe |
| | 16-20 | 11/2 | 20 | 18 18 | 1½ in. round 1½ in. ex. strong pipe |
| | 21-25 | 2 | 24 24 | 18 18 18 18 | 2 in. round 2 in. ex. strong pipe |
| | Over 25 | 3 | 30 30 | 18 18 | 3 in. round 3 in. ex. strong pipe |

TYPICAL TRANSVERSE-JOINT SPACING

| | The state of the s | | | | | | | |
|-----------------------|--|----------------------------------|---|--|--|--|--|--|
| Agency | | Spacing (ft) | Remarks | | | | | |
| FAA | | 20-75 | Recommend intermediate hinge joints @ 1/3 points on long slab; expansion joints not over 1500 ft | | | | | |
| Corps of Engineers | Less than 8 in. | 12.5-15 | Space equal to or 25% more than longitudinal spacing | | | | | |
| | 8-10 in. slabs More than 10 in. slabs | 15-20 20-25 | For 25 ft lanes use longitudina contraction joints in center and space transverse joints @ 12.5-15 ft | | | | | |
| PCA | Crushed granite Crushed limestone Flinty limestone Calcareous gravel Siliceous gravel Gravel less ¾ in. Slag | 25 20 20 20 15 15 | | | | | | |

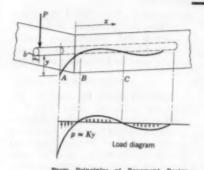
across the joint. Construction joints are used at the transition from old to new construction, such as at the end of a day's pour. In some cases, key construction joints such as shown in Figure 30 (e,f) are used.

Hinge and/or warping joints are used on highways to control cracking along the centerline of the pavement. The type of joint used depends primarily upon the method of pouring the concrete slabs. If lane-at-a-time construction is used, keyed joints may be built. In some cases the key joints are tied together with tie bars to make certain that the key functions in load transfer. This is accomplished by disjointing the tie bar at the pavement form and placing the free end of the tie just prior to pouring the adjacent lanes. If two-lane construction is used on highways, the most convenient longitudinal joint is of the dummy groove type where tie bars are placed at intervals of about three feet. It is important to note that load transfer across a tied joint is brought about by grain interlock, whereas load transfer across contraction and expansion joints is provided by relatively heavy dowel

Tables 8 and 9 indicate typical transverse joint spacing and dowel bar requirements for airports and highways. Expansion joints are very often omitted from highway pavements, except where abutting lanes might move excessively due to pavement expansion, or whenever the pavement abuts a bridge.

Dowel bars provide load transfer by transferring shear across the joint. Figure 31 shows pressure exerted on a loaded dowel. The use of rigorous analysis in the design of dowels is open to some question, since several simplifying assumptions need be made. It must be assumed that dowel bars are perfectly aligned and free to move. Improper alignment or lubrication may cause the dowels to freeze with resultant spalling. In addition, the effectiveness of dowel bars transferring load across a joint depends to some extent upon the characteristics of the subgrade. As a result, most agencies have resorted to standard dowel sizes, wherein the diameter and length of dowel are dependent only upon pavement thickness.

In any event the important factor to consider here is the primary difference between a tie bar and a dowel bar. The purpose of a tie bar is to hold a joint tightly closed so that load can be transferred by grain interlock; in contrast dowel bars transfer load in bearing across



by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1956

 FIGURE 31. Pressure exerted on a loaded dowel across a pavement joint.

the joint and thus, must be relatively heavy in section when compared to ties. Likewise, a tie bar must be firmly anchored in the concrete, whereas a dowel bar must be lubricated and free to move to permit opening and closing of the joint.

Temperature Reinforcement

Wire fabric or bar mat reinforcement may be used in rigid pavement slabs for control of temperature cracks. For most cases, the reinforcement is assumed to add nothing to the structural capacity of the pavements.

Transverse cracks may occur in rigid pavements as a result of warp-

Table 9—Typical Transverse Joints for Highways From Portland Cement Association 1960 Charted Summary

| | | Expansion | Contraction | | | |
|-------|---------------|-----------------------|---------------|------------------|----------------|--|
| State | Spacing (ft.) | Width (in.) | Spacing (ft.) | Width (in.) | Depth (in.) | |
| Ala. | 600 | 1 | 20 | 1/6 | d/4 | |
| Ariz. | * | 3/4 | 60, 15 | 3/16 | 2 | |
| Ark, | * | | 45, 15 | 3/8 | 11/2 | |
| Cal. | * | | 15 | 1/4 max. | 2 | |
| Colo. | | 3/4 | | | ~ | |
| Conn. | | | 15 & 20 | * * * | | |
| Del. | ** | | 61.5, 45 | 011011 | 21/2 | |
| D. C. | 30 | 1/- | 61.5, 45 | 3/16-1/4 | 242 | |
| Fla. | 30 | 1/2 3/4* | | ¼ min. | 277 | |
| | | 94 | 20 | 36 min. | d/4 | |
| Ga. | 600 | -94 | 30 | 1/4 | 2-3 | |
| ld. | *** | * * * | | | 03/ | |
| III. | | | 100 | 3/6 | 23/4 | |
| Ind. | * * * | 3, 1 | 40 | 1/4 - 3/8 | d/4 | |
| Iowa | * | 1* 34* 3* | 20 | 1/8 - 1/4 | 134 | |
| Kan. | * | 34* | 61.5 | 3/6 | d/4 | |
| Ky. | * | 3* | 50 | 1/8 - 1/4 | d/5 | |
| La. | * | 4*, 36 | 58.5, 20 | 36 | 2 or 3 | |
| Me. | * | 1* | 61.5 | 36 | 2 | |
| Md. | 600 | 4*, ¾ 1* ¾ ¾ | 40 | 1/8 | 2 2 | |
| Mass. | | 3/4 | 40 | 3/16 | d/5 | |
| Mich. | | 1* | 99 | | | |
| Minn. | | 1* | | 36 | 1½ or 2 | |
| Miss. | varies | 1 | 39-1/3,20 | 3/6 | 2 | |
| | varies | 2* | 21 | | d/4 | |
| Mo. | | | 611/2, 30 | 3/8 | 11/2-2 | |
| Mont. | ** * * | 34 | 15 | 1/6 - 3/6 | | |
| Neb. | | 1* | 16-1/3 | 1/8 | d/6 | |
| Nev. | * * * | * * * | | * * * | | |
| N. H. | 78-1/6 | 34 | | | | |
| N. J. | 78-1/6 | 3/4 | 15-20 | * * * | | |
| N. M. | * | 34* min. | 20 max. | 1/a - 1/4 3/a | 11/2-2 | |
| N. Y. | * | 7/6* | 60-5/6 | 36 | 2-21/2 | |
| N. C. | * | 1* | 30 | $38 \pm 1/16$ | d/4 | |
| N. D. | | 1 | 20 | 1/8 | d/6 | |
| Ohio | * | 1* | 60 | 3/16 min. | 2 | |
| Okla. | * | 3/4* | 15, 61.5 | 3/s max. | 11/2,2 | |
| Ore. | | 34* | 61.5 | * * * | | |
| Penn. | varies | 34 - 1 | 61.5 61.5 | | | |
| R.I. | 73.5 | 3/4 | 01.5 | | | |
| S. C. | * | 36* | 25 | 1/4 | d/4 | |
| S. D. | * | 1.0 | 25 | 3/6 | 2 | |
| Tenn. | | 1* 34 1½* | 61.5 | | 2 | |
| | *** | 21/4 | 25 | 1/4 | d/4 | |
| Tex. | | 142" | 15 | 1/8 - 1/4 | 0/4 | |
| Utah | *** | * * * * | | | | |
| Vt. | 60 | 1/4 | | * * * | | |
| Va. | | 34* | varies | *** | * * * | |
| Wash. | * | 3/4* | 15 | | * * * | |
| W. V. | 615 | 3/4 3/4* | 31 | 1/4 | 2 | |
| Wis. | * | 34* | 80, 50 | 1/4 | 2 | |
| Wyo. | * | | 20 | 1/8-3/16 | 11/2 | |

^{*}Special locations, such as bridges.

ing stresses, contraction stresses and loading stresses. The cracks themselves may not be detrimental so long as they are not permitted to open appreciably. The amount of steel needed to hold a crack intact is calculated by balancing forces along the horizontal plane. Assuming that a crack will develop, and that resistance to movement will be overcome by tension in steel, Equation 12 results.

$$A_s = \frac{W f L}{2 f_s} . (12)$$

where

 $A_s = \text{required}$ steel per foot of width

W = weight of slab, lbs. per sq. ft.
f = coefficient of resistance (generally assumed to be 1.5)

 f_s = allowable stress in steel

L = length of slab

It is seen in Equation 12 that the amount of required steel varies directly with the length of the slab. Therefore, theoretically at least, the amount of steel can be reduced to zero by shortening the length of the slab. Wire reinforcement is sometimes omitted from airfield pavements due to shorter slabs which are used on these pavements as well as the fact that loads are applied at the interior of the slab rather than at the pavement edge.

Highways with transverse joint spacings ranging between 20 and 100 feet, and with lanes 12-feet wide, require heavier longitudinal than transverse reinforcement. The transverse wires act primarily as spacers, since longitudinal cracking generally does not take place; the warping stresses are relieved by the longitudinal joint.

In general, closely-spaced small wires are more effective than larg-

er-diameter wires spaced at greater intervals. Longitudinal wires with diameters less than those corresponding to No. 4 or No. 3 gauge are seldom used in highway pavements.

Subgrades

Attention must be paid to the type of subgrade over which a rigid pavement is to be built. Heavily traveled rigid highway pavements constructed over fine grained materials nearly always require subbases for control of pumping. Also, frost susceptible subgrades might cause heaving at joints. Field data have indicated that the performance of a rigid highway pavement is not affected to a great extent by type of subgrade as long as a nominal subbase is provided. This fact, however, does not eliminate the need for investigation of a subgrade to determine its compaction characteristics. Compaction to densities of at least 95 percent of the standard AASHO value is desired. During construction, the subgrade should be kept moist so that swell upon subsequent saturation will be minimized.

As a general rule, density requirements should be maintained for a depth of at least 6 inches. Also, it is extremely important to insure that uniform subgrade conditions exist to a depth of two or three feet.

In connection with airfield pavements, the compaction requirements of the Corps of Engineers state that the top 6 inches of the subgrade in cut sections exclusive of cohesionless sands and sandy gravel subgrades should be compacted to 90 percent modified AASHO density. For cohesionless sands and gravels, the top 6 inches of fills should be compacted to 100 per cent modified AASHO and the remaining fill may be compacted to 95 percent modified AASHO.

In the case of both highway and airfield pavements, care must be taken to remove isolated pockets of frost susceptible material, and to make certain that sufficient sub-base is provided to minimize frost action.

Subbases

Considering first highway pavements, subbases may be used for several reasons, including control of pumping, control of frost action, and control of high volume change soils. The choice of subbase type depends in part upon the availability of high grade aggregates. In general, open graded materials are recommended for control of pumping. Subbases for control of frost action must be non-frost susceptible and free draining.

The required thickness of subbases under rigid highway pavements depends upon a number of factors. If frost action is a problem, subbases to the full depth of frost penetration are warranted if an adequate supply of materials is available. For control of pumping, field data have shown that nominal depths as small as 4 to 6 inches are satisfactory. Depth of subbase has very little effect upon pumping.

A major factor which determines the thickness of subbase under rigid pavements is construction technique. In addition to control of pumping and frost action, a function of a subbase is to provide a working platform upon which to build a pavement. If it is difficult to run heavy equipment over the subgrade, it may be necessary to increase the thickness of the subbase as a construction expedient. Also, when soft spots develop in the subgrade during construction, the approach of partially excavating the subgrade and backfilling with additional granular material is generally the most economical.

Subbase courses must be compacted to relatively high densities to preclude consolidation and subsequent distress. Compaction of the subbase to at least 95 percent standard AASHO should be required: 100 percent compaction is desirable and densities in excess of this may in some cases prove beneficial. Standard AASHO grading requirements for soil-aggregate mixtures are given in Table 10. Types A and C. in general, work quite satisfactorily for control of pumping. Detailed studies should be made of the availability of various subbase materials and provision should be made to process low-grade aggregate if needed. As a general rule, pit run

Table 10—AASHO Grading Requirements for Soil-Aggregate Mixtures

Per Cent by Weight Passing Square Mesh Sieves Grading Grading Grading Grading

| Sieve Designation | Grading A | Grading B | Grading C | Grading D | Grading E | Grading F |
|----------------------|--------------|----------------|---------------|----------------|---------------|---------------|
| 2 in. | 100 | 100 | | | | |
| 1 in. % in. | 30-65 | 75-95 40-75 | 100 50-85 | 100 60-100 | 100 | 100 |
| No. 4 | 25-55 | 30-60 | 35-65 | 50-85 | 55-100 | 70-100 |
| No. 10 | 15-40 | 20-45 | 25-50 | 40-70 | 40-100 | 55-100 |
| No. 40 No. 200 | 8-20 2-8 | 15-30 5-20 | 15-30 5-15 | 25-45 10-25 | 20-50 6-20 | 30-70 8-25 |

¹⁾ Coarse aggregate shall have a percentage of wear by the Los Angeles test of not more than 50 per cent.

 Fraction passing No. 200 sieve shall not be greater than two-thirds of fraction passing No. 40.

³⁾ Fraction passing No. 40 sieve shall have liquid limit not greater than 25 per cent and a plasticity index not greater than 6 per cent.

sands and gravels will cost less than processed materials, and therefore, many states use natural deposits whenever possible. Natural deposits, however, should be investigated in great detail and adequate specifications set up for their use.

Dense graded subbases are nearly impervious; hence, drainage installations are generally not warranted and the materials may be constructed in a trench. Open graded subbases, however, should be drained to preclude trapping of water and subsequent softening of the subgrade.

Pumping is generally not a problem on airfield pavements except when the pavement is subjected to overload conditions. Therefore, many airfield pavements have been built without a granular layer between the pavement and subgrade.

For protection against frost action, the subbase within the frost zone should be non-frost susceptible. Subbases increase the load carrying capacity of the subgrade to a certain extent; thus, the design subgrade modulus should take this into account. Plate bearing tests can be made upon the subgrade and then upon some arbitrary thickness of the subbase. The increase in subgrade reaction with increasing depth of subbase can be determined from these data.

Pavement Strengthening

Pavements may become inadequate because of increased weight and repetition of loads applied to them, but they also may become inadequate due to durability properties of the concrete. Whenever a pavement becomes inadequate, several solutions are possible. First, it may be feasible to reduce the stresses applied to the pavement by restricting gross loads and tire pressures of aircraft and heavy trucks. Second, the pavement may be resurfaced for the purpose of restoring smooth riding qualities. Third, it may be necessary to design an overlay which not only restores a smooth riding quality to the pavement, but which in addition increases the structural capacity of the pavement appreciably. The fourth and remaining solution is to adopt complete reconstruction.

Flexible overlays on rigid pavements can be designed by use of Equation 13.

$$t_f = 2.5 (F h_d - h)$$
 . (13)

where

 h_d = required depth of rigid pavement

Table 11—Federal Aviation Agency Values of "F" For Flexible Overlays

| | | Value of "F" When | Subbase Is | Classed as Below | |
|----------------|----------------------|---------------------|--------------------|------------------|-----|
| Subgrade Class | Ra* | Rb | Rc | Rd | Re |
| Ra Rb | 0.8 | 0.8 | | | |
| Rc Rd Re | 0.94 0.98 1.00 | 0.9 0.94 0.98 | 0.8 0.9 0.94 | 0.8 0.9 | 0.8 |

*Values in this column apply when no subbase has been provided

Table 12—Values of Coefficients For Use in Equation For Rigid Overlays

| | | Coefficient | | | | |
|-----------------------------|----------------------------------|-------------|------|------|------|--|
| Agency | Condition | C | × | у | n | |
| Corps Engineers FAA, PCA | Existing pavement good condition | 1.00 | | | | |
| | Initial breaks | 0.75 | | | | |
| | Badly cracked | 0.35 | | | | |
| Corps Engineers | Pour directly on old pavement | | 1.40 | 1.40 | 1.40 | |
| | Leveling course | | 2.00 | 2.00 | 0.50 | |
| FAA, PCA | Pour directly on old pavement | | 1.87 | 2.00 | 0.50 | |
| | Leveling course | | 2.00 | 2.00 | 0.50 | |

h = existing depth

F = factor which is a function of the subgrade and subbase (see Table 11)

Rigid overlays over existing rigid pavements can be determined by the use of Equation 14.

$$t_r = (h_d^s - Ch^b)^n$$
. (14)

where

t, = required depth of rigid pavement

h = existing depth

C, x, y, n =Coefficients (see Table 12)

Equations 13 and 14 give overlay thickness required to restore structural capacity of the pavement. This concept is contrasted to that of placing thin overlays over the pavement merely to restore smooth riding qualities. The choice of overlay and method of reconstruction depends on many factors, including relative roughness of a pavement, magnitude of anticipated traffic, availability of construction materials and many others.

Foot Notes

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What you should know about Managing Sewage Treatment Works

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WITHIN recent years the opera-tion and maintenance of sewage treatment plants, particularly those serving large cities, has become big business. Many of these plants, such as those of New York City, Chicago, Los Angeles, Pittsburgh and Washington have cost millions of dollars to construct and require the services of highly skilled personnel, including engineers, chemists, electricians and mechanics. In many instances the cost of operation exceeds \$1,000,000 a year.

Funds spent on operation should be put to the best and the most economical use for the purchase of supplies, for the making of repairs and for the employment of skilled and unskilled labor. The aim should be to produce an effluent that will not be detrimental to the watercourse into which it discharges nor create other nuisances.

Know Your Plant

The operator should know intimately all parts of his plant and also the characteristics of the watercourse receiving the effluent. He should know the volumetric and organic loads being applied to the various treatment units and the maximum load they can safely handle. He should have drawings to scale of the plant and its component parts. He should have readily available information as to the sizes, capacities and efficiencies of pumps, motors, blowers, compressors, gas engines and other equipment. Other essential information includes the manufacturers' drawings, descriptive literature and test data of the major pieces of mechanical and electrical equipment. It is desirable to have diagramatic drawings of the water, sludge, gas and other pipe lines in the plant. At many sewage plants such diagrammatic drawings are framed for quick reference. Electrical wiring diagrams should also be available. The cost of the plant and of the additions made to it should be on record.

The daily sewage flow records should be kept; maximum and minimum daily rates of flow should also be recorded. Analyses and determinations of quantities of grit, sludge and sludge gas collected should be known. The extent and the frequency of making these analyses will depend upon the size and the importance of the plant. Records should be kept of the amount of electric power used at the plant and the annual operating and maintenance costs. Each year an estimate should be made of the number of persons served. When the sewage contains a good deal of industrial wastes, it is often desirable to know the equivalent population load of these wastes.

The operator should know the amount of organic load that can be applied to each unit of the plant. It quite frequently happens that some units are loaded up to or beyond their normal capacity while others are considerably over size. Having this information, the operator can advise the proper authorities what additions should be made from time to time to the plant.

Know Your Limits of Authority

A sewage plant superintendent, especially one who is employed by a municipality and who has a number of men reporting to him, must know not only the technical phases of his job but also details of a policy nature. He must know the degree of his authority relating to each phase of his work, to what extent he has authority to make changes at his plant, to hire and fire employees, to purchase materials, to discipline employees, etc. If his employees belong to a union, he must be familiar with the union contract and know how the contract affects his relations with them.

Every plant superintendent should have an assistant who can assume the duties of the superintendent if need be. Furthermore, the organization of the personnel should be such that every employee who holds a key position has a substitute to take over his duties if necessary.

Know Your Employees

At large plants with a considerable number of employees it is helpful to have regular conferences with supervisors and foremen, where problems relating to the operation of the plant can be discussed. By following this procedure many ideas dealing with the plant and its operation, which the superintendent may not have considered, can be discussed and evaluated. The morale of assistants and foremen will be stimulated if they are permitted to express their views and are made to feel that they play a vital and important role in the operation of

At plants where the workmen are classified into several grades, plans should be instituted so employees will have the opportunity to ad-

Check List of Managerial Qualities

- Do you know the operating characteristics of plant units and equipment under all possible conditions?
- Do you know the actual limits of your authority over personnel and in purchasing?
- Do you allow your employees to be part of a team and give them a morale-building classification and compensation plan?
- Do you have a public information and relations program?
- Do you and your staff keep up to date with developments and take advantage of research opportunities?
- Do you provide complete monthly and annual reports for your superiors and for the public health authorities?
- Do you practice that dominant principle of executive control, supervision by leadership?



vance from lower to higher grades. To execute such a plan it may be necessary to provide special training for the men. Where possible, it is preferable to promote employees to more important positions than it is to secure the services of someone not working at the plant.

The salaries of personnel should be commensurate with what they do. Unfair inequalities in pay should be avoided. Many factors govern the compensation to be paid employees, such as training, experience, length of service, skill, quality and quantity of work done, reliability, cooperation, originality, etc.

It is essential that supervisors and other trained employees have a feeling of security in their jobs. Having a new group of men appointed at each change of administration of a municipality is most demoralizing. In recent years this condition has greatly improved with the adoption in many cities of the merit system of appointments.

Keep the Public Informed

Where a plant is financed by public funds, it is usually wise to give the plant as much publicity as possible. If this procedure is followed, the public will more likely be kept aware of the part played by the plant in keeping the receiving watercourse in a satisfactory condition and of the importance of operating the plant at its maximum efficiency. Opportunities should be afforded students at schools and colleges, members of women's clubs and men's organizations to inspect the plant. Opportunities to publicize the plant, the problems encountered in operating it and its future needs, in the press and at public meetings should be welcomed. Having available for general distribution a brochure describing the plant is desirable. This brochure should contain the important items of interest such as the quantity of sewage being treated; the estimated number of

persons served; the type of sewer system tributary to the plant; a flow diagram of the plant; the number, sizes and capacities of the various treatment units; analyses of the waste; the original cost of the plant and of the additions made thereto; and annual operating costs and other pertinent data.

Maintaining plants in a tidy and neat condition is of the utmost importance. Buildings and other structures should be kept clean and well painted. Lockers should be provided in buildings for the storage of clothing, tools and equipment not in use. Containers should be available for the reception of waste paper, empty bottles and other trash. Broken window lights should be promptly replaced. Lawns and banks should be kept trimmed and in good condition. The planting of trees, shrubs and flower beds in suitable locations is desirable. Providing potted plants in buildings adds to the attractiveness of interiors.

The plant operator should keep in close contact with the health department personnel of the state in which the plant is situated. Their regulations should be strictly followed. They should be kept informed with regular reports giving the sewage flow, the analyses of the sewage and the effluent and other pertinent operating details. The health department should be notified in case it should be necessary to bypass the sewage plant or any part thereof. It should be remembered that state health departments are always ready to render technical assistance in solving operating problems.

Keep the Staff Informed

The plant operator and his assistants should make continued efforts to increase their knowledge of all phases of sewage treatment. It is most desirable to have a good understanding of the various sciences upon which sewage treatment is based. The more physics, chemistry, biology, hydraulics and engineering that an operator knows, the better he will be equipped to solve the problems confronting him. In many instances operators live in localities where they can attend evening courses of study, dealing with scientific and engineering subjects. Correspondence schools and television also afford opportunities to broaden one's knowledge of the sciences. Many state sewage works associations give courses of instruction annually or oftener. Several universities hold conferences yearly, at which papers devoted to sewage



and industrial wastes treatment problems are discussed.

Operators and their assistants should seek membership in and attend the meetings of sewage works associations and similar groups. Subscribing to and reading the journals, magazines and technical reports pertaining to sewage treatment problems is most desirable. Every plant of any importance should maintain a library of books and literature dealing with sewage treatment.

City administrators, state health departments, engineering schools and manufacturers of sewage plant equipment should be made to realize that the future of water pollution control depends to a considerable extent upon the knowledge gained from research. A sewage treatment plant can often serve as an excellent location for conducting such investigations. At mediumsize and large plants where laboratories are adequate and several chemists and technicians are employed, this statement is particularly true. Sewage plant operators and those to whom they report should do everything possible to advance the science of sewage treatment by promoting and conducting research.

Keep Your Associates Informed

Except at the very smallest plants a yearly report, giving the details of operation, should be prepared. The length of the report and the information contained in it will depend to a considerable extent upon the size and the importance of the plant. The report should contain details regarding any improvements and changes made. A description of the improvements, the cost and date of being placed in service should be given. The average, maximum and minimum sewage flows and the estimated number of persons served should be stated. The analyses of the raw sewage and of the discharge

from each treatment unit should be recorded. The analyses and the quantities of grit and sludge should be indicated. Furthermore, the analyses and the quantities of sludge after it has been digested, dewatered and given further treatment should be noted. The report should also include the cost of operation. At large plants it is often desirable to determine and record the cost of operating the individual treatment units.

Be a Leader, Not a Boss

At medium-size and large plants where there are a number of employees, the superintendent must have executive ability in order to get the best results. Many well trained men fail as executives because they do not have the necessary managerial qualifications. As has been previously stated, one of the most important qualifications for a plant superintendent is to know his plant thoroughly and to have a good knowledge of the principles of sewage treatment. This knowledge will bring with it self confidence, a most desirable characteristic for those who direct the activities of others.

One of the aims of a sewage plant operator should be to develop and to utilize to the fullest extent the capabilities of each employee. To accomplish this purpose there are several principles that should be followed. It is of prime importance that each worker have a sense of satisfaction in his work, his supervisor, his associates and the organization employing him. It should be the purpose of every supervisor to accomplish this desidera-tum. It is essential that care be taken in selecting employees. Workers should be assigned jobs for which they are best fitted as a result of their training and experience. Assigning to employees duties with which they are not familiar, or giving them tasks that require only a fraction of their skill and knowledge is not conducive to good morale.

Supervisors should make a point of indicating their appreciation to personnel for work that is well done. When an employee is assigned a task, his effort to do it efficiently and satisfactorily will frequently be stimulated by indicating a faith in his cooperation and ability. For example, making a statement such as—"This job is an important one; I am giving it to you, because I know you will do it quickly and well"—will frequently boost his morale and will indicate

confidence in his ability. In general an employee whose work is appreciated will derive a greater satisfaction from his accomplishments, which will be reflected in his doing more and better work.

Employees should have a part in planning those things that affect their working conditions. If changes are made that adversely affect a worker, he should be told the reason for making the change. An employee's pride in his work should be stimulated. He should be told the reason for making the change. An employee's pride in his work should be stimulated. He should be told the importance of what he is doing.



Every employee should know to whom he reports and who reports to him. In general, each employee should report to one and only one supervisor.

The working environment of employees should be properly maintained. A spirit of congeniality among the personnel should be fostered. Moreover, the equipment, buildings and grounds should be kept in a clean, presentable appearance so that each worker can have a sense of pride in the plant. Adequate steps should be taken to promote his safety.

A good executive should display self control at all times. Giving way to expressions of irritation or bursts of anger should be avoided. Making decisions and directing operations when one is irritated or angry puts one under an undesirable handicap. It is the cool, level-headed man who is the best leader.

Another desirable qualification for a superintendent is to be a good organizer. He should know the number, the type and the qualifications of the men who are to be assigned to various tasks, the time required to complete various projects; and he should be able to judge whether a job has been done satisfactorily or not. A superintendent's directives should be clear so that his assistants will know what is expected of them. In many instances, where it is important that there be no misunderstanding, it may be desirable to prepare and furnish a written protocol for the employee to follow. This policy is often desirable when an experiment is to be conducted or a certain procedure is to be followed in the operation of equipment.

It is important to insist at all times upon getting the best efforts and work from subordinates. Sloppy work should not be permitted. If a worker is found to be doing a job inefficiently or improperly, he should be told the proper way to do it and the reason for doing it that way should be given.

A supervisor should never play favorites; he should always treat all of his employees equally fairly. It is unwise to discuss the faults of one employee with another employee of the same general rank. Employees should be respected as persons and made to feel that they are not cogs in a machine but that their supervisor is interested in their problems, their welfare and their progress. Much can be gained by being friendly and sympathetic.

It is well to listen attentively to the complaints and suggestions of employees. There are always two sides to every question. It often happens that employees' complaints have merit and should be given consideration. Getting employees to offer suggestions regarding plant operation should be encouraged. Frequently worthwhile ideas can be obtained by following this practice.

The supervisor who can win an employee's loyalty and cooperation by persuasive methods will generally accomplish more than if he forces the subordinate to comply with his directives. Leadership is not merely a matter of giving orders but of arousing a desire on the part of an employee to put forth his best efforts to be of service.

The sewage plant manager has a most important role in maintaining the cleanliness and attractiveness of watercourses. Upon his efforts depend to a great extent the suitability of watercourses for recreational purposes, the control of enteric diseases, the navigability of waterways and the availability of an adequate supply of suitable water for industrial and domestic use. Since the sewage works manager's position is one of vital importance to a community, his selection should be made with great care.

Turbidity Removal With COARSE GRAINED FILTERS

LOREN E. HEIPLE

Head, Civil Engineering Department,

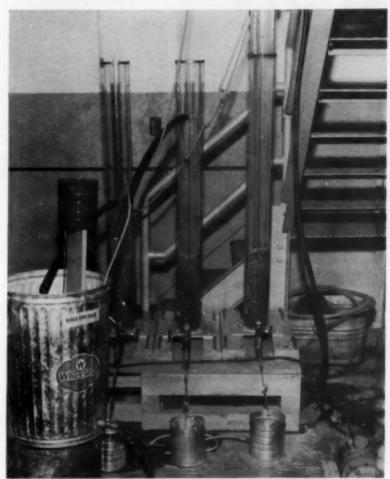
University of Arkansas

RESEARCH program was ini-A tiated in 1955 by the Civil Engineering Department of the University of Arkansas with the express purpose of determining a feasible method of producing a low turbidity water from highly turbid surface water collections. The object of this study, initially financed by Winthrop Rockefeller of Morrilton, Arkansas, was directed toward using a low turbidity effluent as a water supply for 1) recharging depleted underground aquifers, 2) domestic use in rural homes and other agricultural operations and 3) use in remote institutions where well supplies are not available.

Intensive investigation was begun on the application of coarse grained media as filtering agents for the removal of colloidal and non-colloidal sized particles in natural waters. Brief and fragmentary reports indicated that suspended matter could be partially removed from turbid water with gravel filters. Laboratory investigations supported by a field study of pilot plant scale indicate that a substantial portion of the suspended particles in turbid supplies can be removed with coarse grained media. A 500-gpm field installation is now under construction, the effluent of which is to be used for ground water recharge experimentation.

Laboratory Investigations

A basic preliminary study was begun in the laboratory in order to establish design parameters for field units. Initial investigation utilized 4-in, diameter lucite cylindrical filters to permit visual observation of filtration. Raw water consisted of both settled pond water and an artificially prepared source using ceramic clay for a suspension. Laboratory experimentation was designed to furnish the following information: 1) The effect of the depth of filtering medium on filtration action, 2) the relationship between size of filtration media and filtration effectiveness, 3) the effect of increased depth of water on top of filter me-



● LABORATORY set-up, showing three of the 4-inch lucite cylinders which were used in the preliminary work. The lucite permitted visual observation of filtration.

dia as filtration efficiency and 4) the effect of turbidity particle size on filter operation. Preliminary studies indicated that coarse grained filters are most effective when operated at an upper limit of filtration rate of 0.1 to 0.2 gpm/sq. ft. At this low rate no loss of head due to increased frictional resistance from clogging was noticed on any of the long-term filtration tests.

All filtration tests indicated that there is a ripening effect where filtration action improves with time of operation. This effect was more noticeable in shallower beds than in the thicker layers of filter medium. Overall operations indicated that a bed depth of one foot minimum was required, with deeper beds showing slightly higher efficiencies.

As might be expected the finer the filter stone the more effective the turbidity removal, but the increase in efficiency was not nearly as great as anticipated. Under the conditions where a given depth bed of 1 to 1/2-in. limestone would give an effluent of 17 turbidity units; 1/2 to 1/4-in. crushed limestone would pass an effluent of 13 units; and 1/4-in. to No. 10 crushed limestone might produce a filtrate of 9 units. Whether the media was angular crushed rock or a rounded river gravel seemed to have little effect on filtering action. The surcharge depth of water over the filter bed



PILOT PLANT installation, showing arrangement using a surface water source. A
 4-inch lucite filter, shown at the left, permitted visual control of the processes.

appeared to have only slight effect on the action of the filter as long as the filter was continuously submerged. Evidence points to the surprising fact that a coarse grained filter is quite effective in removing colloidal suspensions as well as mixtures of larger suspended particles in the raw water supplies.

Pilot Plant Installation

A field installation located on a small artificial lake enjoyed a continuous filter run of one year before the collected turbidity finally broke through giving an effluent of higher turbidity than the incoming raw water. This pilot filter, 431/2 inches in diameter, included a 16-in. layer of ½ to ¼-in. river gravel under a 28-in. depth of raw water maintained at a constant level. A rate controller at the outlet of the perforated pipe collector system restricted the flow through the filter to 0.1 gpm/sq. ft. The raw water intake was placed in the lake source at a depth of 11 feet below spillway level.

Raw water turbidity ranged between 40 units and 600 units with a mean value of 75. Major fluctuations were noted after heavy rains due to high surface runoff. The filter was housed in an unheated building to restrict freezing of the filter. Operation commenced in August was continuous throughout the winter. Reduction in turbidity was chosen as the primary measure of filter efficiency. Under most conditions the filter maintained a turbidity removal of well over 50 percent

and in some instances was over 90 percent removal. The maximum removal efficiency of 92 percent was indicated with low raw water turbidity (40 units), after no recent heavy rains, and after the filter had been in operation for 5 months. On the other hand, the minimum reduction in turbidity, 36 percent, occurred during a heavy algae bloom when the unit had been in operation less than a month. General conclusions to be drawn regarding turbidity removal are: 1) the filter is rather efficient in removing all suspended solids but is more effective in removing a colloidal suspension than the larger non-colloidal sized particle; 2) the greatest weakness was observed in the removal of live algae; 3) the aging of the filter by use causes a marked improvement in filtration action; 4) the efficiency of turbidity removal is inversely proportional to the raw water turbidity; and 5) seasonal variations are minor except for the indirect effect of high raw water turbidity following intense summer rainstorms

Limited tests on bacterial removal were made after the filter had been in operation 7 months by the membrane filter technique indicating total bacteria counts per 100-ml. sample. The reduction in bacteria paralleled closely turbidity removal with a low of 46 percent removal, a high of 76 percent removal and an average reduction of 61 percent. The pilot field experiments begun on August 15th were suspended 379 days later after a 5-

in. rainfall on July 7th raised the lake turbidity to a maximum of 760 units with a filtered effluent turbidity of 115 units. From this time on the filtrate became progressively worse until on August 14th, the effluent, for the first time, contained a turbidity higher than the influent. During this protracted operation, approximately 525,000 gallons of water passed through each square foot of the 16-in. deep filter

Prototype Field Filter

Now under construction, and soon to be placed into operation, is a 500-gpm/sq.ft. coarse grained filter built on the site of a ground water recharge project at the University of Arkansas Agricultural Experiment Station near Stuttgart, Arkansas. This unit is designed to take turbid water from shallow reservoirs and, without preliminary treatment, remove the majority of the suspended particles. Filtration will be the first step in preparation of pond water for recharge experimentation into a partially depleted aquifer through injection by wells.

To minimize the possibility of contamination of existing aquifers in the recharge operations, all water is chlorinated as recommended by the Arkansas State Board of Health. In addition, chemicals have been introduced as tracers to determine the path and flow of recharged water.

Unusual Type of Water Evaporator for the Middle East

A fully self-contained mobile seawater distillation plant which will produce 17,250 U.S. gallons of drinking water a day has been sent to the Sheikdom of Abu Dahbi, on the Trucial Coast, by Richardsons Westgarth. Currently the only supply of drinking water in Abu Dahbi is brought in by sailing dhow at considerable expense.

The unusual feature of this evaporator is that it has been designed to float on its own pontoon. There are no port facilities at Abu Dahbi and the complete plant will be lowered into the sea some miles off the coast and towed in to the beach. With the aid of a winch, which forms part of the unit, it will then be hauled up the beach on to a cement foundation. It remains only to connect up to a fuel supply and seawater pipes and the vacuum flash evaporator will be ready to produce fresh water. The pontoon remains part of the plant and will be used for storage of the product water.



JOHN G. KRIEG

City Purchasing Agent,

Cincinnati, Ohio

FOR SEVERAL reasons, compact cars have become of considerable importance to local governments. In part this is due to the elimination of special discounts previously granted by certain manufacturers on the purchase of standard-sized vehicles by governmental agencies. In addition there is the ever increasing need for local governments to stretch the tax dollar to meet their citizens' demands for new or expanded services at a time of constantly rising labor and material costs.

During the early part of 1959, the City of Cincinnati conducted experiments with cars of the so-called compact class to determine their adaptability for city services and to investigate the possibility of savings which might result from their use. On the basis of these limited tests. the decision was made to modify our specifications to permit bids on the compact class cars for certain uses. Specifications for this class of vehicle were established from the standpoint of what we felt represented our minimum acceptable requirements, taking into consideration both power and space needs to handle equipment and personnel associated with the use of these vehicles.

A total of 40 campact cars were purchased by the City of Cincinnati in mid 1959 and were assigned to uses for which they were deemed adaptable. To indicate the extensiveness of this usage, subsequent to purchase these vehicles were assigned as follows: 22 to the police department, with 9 of these assigned to district plainclothesmen and district captains; 11 to detective forces, including the vice squad, juvenile bureau and other unmarked car services: 1 to the motor vehicle liaison officer and 1 to regular downtown patrol service for further experimental evaluation; 5 to the waterworks department; 4 to public works divisions; 2 to safety department divisions other than police: 2 to health department; 2 to urban renewal department; 1 to recreation commission; 1 to park department; and 1 was purchased for the University of Cincinnati. The ultimate aim was a thorough determination of whether or not they fulfilled the usage demand in various services and also whether savings would result.

Savings Average 1¢ per Mile

Initial purchase cost of the 40 compact cars averaged \$253.50 per unit less than the price quoted on standard-sized vehicles incorporating identical equipment or a total saving in excess of \$10,000. This differential in original cost is equivalent to a savings of over \$.004 per mile if usage of 60,000 miles before replacement is anticipated. On the basis of maintenance and operation cost records for nine months, it would appear that a savings of approximately 1¢ per mile will result from the use of this type of vehicle in the services to which they were assigned. Whether or not this saving will continue throughout the practical life of the vehicle remains to be seen: however the indicated savings compare favorably with savings figures reported by other users of considerable fleets of this type of vehicle. Also, reports from other areas indicate that further savings may accrue from better tire mileage and conceivably by a reduction in accident repair costs.

On the basis of the preliminary data available at the time of our vehicle purchases in 1960, the city purchased 16 more compact class cars, including two each of the new entries in this field by the "Big Three" of the auto industry. [Ten more campacts were purchased at the end of 1960.-Ed.] Again in 1960 the purchase price of the compact cars reflects a cost differential of considerable importance and basically comparable to the differential which existed in 1959. Specifically, costs were \$239.77 per unit less on two-door compact sedan and \$225.32 per unit less on a four-door compact sedan than those quoted on standard sized vehicles including the same accessory equipment.

In addition to the savings factor. it is pertinent to comment on the reactions of users of these vehicles. Generally the acceptance has been good, particularly from the standpoint of maneuverability in close quarters, such as in getting into areas where off-the-road operations are in progress, in maneuvering through traffic tie-ups in order to arrive at the seat of the trouble, and in parking in congested areas where parking space is often found to be at a premium. Users of the compacts purchased initially had some complaints on the acceleration and hill-climbing ability of these vehicles, particularly for use in police



 FOUR OF the compact cars of the City of Cincinnati. Forty of these cars were purchased in 1959 for use by a number of divisions to determine their adaptability.

activities. This, we feel, has been basically overcome through substitution of a 4.10 ratio axle for the standard 3.73 ratio axle initially furnished. Possibly this factor should have been anticipated as a requirement here in the hilly terrain of

Cincinnati, since this same substitution of higher ratio axles had been required for years in standard size vehicles until the horsepower-toweight ratio was increased as new and more powerful engines were introduced. In this connection, our specifications for purchase of vehicles in 1960 established performance standards in relation to top speed, gradability and acceleration for each class of vehicle being purchased by the city, namely compact size, standard size, and high-performance speed vehicles. On the basis of acceptance tests it is felt that these requirements have fully accomplished the intended purpose.

In addition to this performance complaint, some criticism was offered in relation to the head room provided by the compact class of vehicle. However, it should be pointed out that these same criticisms have frequently been voiced in regard to specific makes and models of standard size vehicles.

On the basis of these total factors, we believe the City of Cincinnati will continue to explore the practicability of greater use of the compact vehicle in various city automotive services.

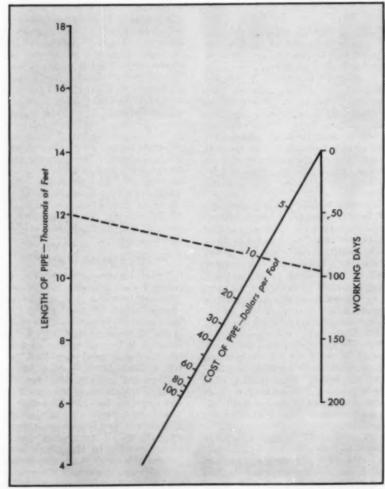
HOW LONG WILL IT TAKE TO COMPLETE THE SEWER?

BENJAMIN C. SEAL City Engineer, Kenosha, Wisconsin

THE accompanying nomograph for estimating time required to complete a sewer project has been worked out by the writer, using data collected over a period of seven years. Sewer costs have been adjusted to 1960 prices.

The cost of pipe in dollars per foot is arrived at by taking the entire cost of the project and dividing it by the number of feet of pipe used on the project regardless of pipe size. The data were obtained from 32 jobs ranging in size from \$12,000 to \$330,000 with pipe costs from \$5.40 per foot to \$100 per foot, and which required from 16 days to 145 days to complete.

In the nomograph the dash line indicates that a job involving 12,000 feet of pipe at an average cost of \$10 per foot would take 95 days for one crew to complete.



NOMOGRAPH of time required for sewer projects using one crew and 1960 costs.

Package Plants FOR SEWAGE TREATMENT

THERE ARE now available a number—some 15 or more—package plants for treatment of small volumes of sewage. Some of these are designed so that they may be shipped in one piece; or, in the case of others of them, may be assembled readily on the job. The capacity ranges from 150,000 gallons per day or thereabouts, down to that sufficient to serve only a few houses. Package plants are mainly of two general types, those employing the total oxidation concept of activated sludge and those utilizing trickling filters.

Many or most of these package plants have provisions for accessories such as a comminutor, chlorine contact tank, pumping unit and metering device. In some cases these units are also prefabricated and ready to bolt or otherwise fasten into place. In others, these must be supplied and installed separately.

A high degree of treatment is usually provided as this is a necessity for the usual small installation. Both types of plants are generally satisfactory in this respect, producing effluents of 20 to 25 mg/L BOD or perhaps less. Ability to operate with a minimum of attention is a desirable attribute which is shared by most of the plants; but a reasonable provision for operating care should always be made, since no plant will continue indefinitely to produce satisfactory results without some intelligent and more or less assiduous attention.

In this article, brief descriptions are given of those package plants on which information is available to the Editor. In order that readers desiring more detail can obtain it most readily, a list of the literature available from the various manufacturers is given on page 46 of this issue. Readers may write directly to the manufacturers or they may use the return postcard facing page 34.

These small plants are especially useful for shopping areas, motels, restaurants, country clubs, resorts, small developments and highway service areas. Many of them can be salvaged, when the need for them

at the original site has passed, and used elsewhere.

There has been a rather general recognition by state sanitary engineers of the need for and utility of this type of plant. Most states will now permit their installation under most conditions. In all cases, however, approval is necessary, usually

by the State Sanitary Engineer, but sometimes by city or county sanitary engineers; and plans for the installation should, and usually are required to, be provided and signed by a licensed professional engineer.

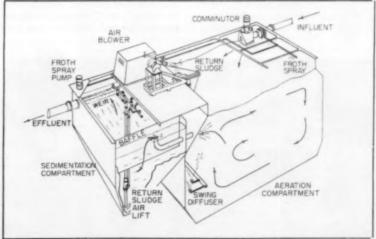
Fencing may be required, especially on open type plants, but is desirable for all.

DESCRIPTION OF UNITS

Chicago Pump Co.-The "Rated-Aeration" plant of this company is contained in a cylindrical steel tank. but it is also available as a built-inplace unit for larger installations. The package unit, which is designed is several sizes for flows from 1,000 to 15,000 gallons per day, incorporates a comminutor, aeration tank, forced air blowers, a clarification tank and an air-lift sludge pump. The aeration system is designed to be clog-proof. The treatment provides removal of 75 to 85 percent of the BOD. The plant can be installed above or below ground or adjacent to buildings; it is said to be entirely odor and nuisance-free; and it is completely standardized and packaged, ready for installation with a minimum amount of work.

Infilco Inc .- The "Accelo-Biox" by Infilco is designed for population of 75 to 3,000. It utilizes the activated sludge method, with total oxidation, employing mechanical aeration or a combination of mechanical and compressed air aeration. BOD removals are said to be in excess of 85 percent. If desired, a small sand filter with automatic backwash can be used to polish the effluent Type A plants employing atmospheric oxygen and using one aerator are available in 7,500 to 37,500 gpd; with two aerators from 42,500 to 70,000 gpd; and with three aerators to 125,000 gpd.

Two other types of plants are available in addition to Type A. Type B employs mechanical turbine type aeration and provides the same capacity range as Type A. Type C,



Courtesy Chicago Pump Co.

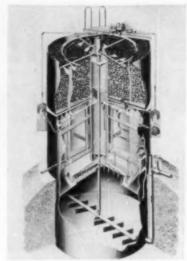
● ACTIVATED sludge type package plant in steel tank, handles to 15,000 GPD.

using a single aerator in a circular tank, provides for flows of 7,500 to 50,000 gpd.

Complete plants include mechanism for aeration, recirculation and clarification; compressors if required; motors; and electrical controls. Units may be installed in concrete or steel structures.

Dorr-Oliver Inc .- The "Completreator" of Dorr-Oliver incorporates all the necessary features for sewage treatment in a single tank. The maximum tank size, overall, is 11.5 ft. diameter and 19.75 ft, high. This is the maximum size tank that can economically be shipped as a unit by rail or truck. The plant is a twostage Biofilter and provides primary settling, primary and secondary filtration, secondary settling, a recirculation wetwell and sludge digestion. The maximum treatment capacity is 150 persons or the population equivalent thereof. The Completreator is delivered at the site, wired and completely assembled, ready for easy installation and operation. The manufacturer states that treatment results are comparable to those obtained from largescale Biofilters, which means a BOD reduction of the order of 85 to 90 percent.

Link Belt Co.—The "Bio-Pak" package plant utilizes two-stage Biofiltration and is designed to meet the so-called 10-State Standards. The primary settling tank has a surface loading rate of 600 to 800 gals./sf/day and the secondary tank 800 gals.; water depths are 7 ft. The organic loading on the filters ranges from 22 to 45 lbs. of BOD per 1,000 cu. ft. of media, or 0.6 to 1.2 lbs. per cu. yd. Filters are 5 ft. deep. Distributors are motor driven. Mechanical sludge collection is provided and the digester compartment has 8 cu. ft. capacity per capita. Auxiliary



Courtesy Link-Belt Co.

TWO-STAGE biofilter meets the socalled 10-state standards of plant design.

unit pump, comminutor, flow meter and contact tank are available. The containing tank is of steel, protected by an epoxy resin coating and magnesium electrodes. The plant is furnished in several sizes for serving up to 500 people. The smallest standard unit is designed to serve a population equivalent of not more than 50, providing 8½ lbs. of BOD daily. In a year-long test run, on sewage of 250 mg/L BOD, the average effluent contained 30 mg/L, representing a reduction of 88 percent.

Eimco Corp.—This firm utilizes the aerobic digestion process in two types of plants. The ADR, which has a capacity range of 1,000 gpd to 15,000 gpd in nine models, is placed in a rectangular steel tank divided into aeration and clarification compartments. The steel tank is anchored to a concrete slab; but the tank may be of concrete, if desired. Tanks are rectangular and lengths range from

10.5 ft. to 30 ft.; widths from 4 ft. to 10 ft.; and depths from 6.8 ft. to 10.5 ft. The ADC plant is provided in the capacity range of 20,000 gpd to 200,000 gpd. In this, the maximum number of parts are fabricated to minimize field assembly. This unit is designed for a circular tank with the aeration compartment surrounding the settling and clarification unit. The least costly installation is said to be a concrete bottom slab with a 1/4-in. steel shell for welding. Aeration tank diameters range from 20 to 65 ft. and clarifier diameters from 10 to 30 ft.

Yeomans Bros. Co.-A variety of small installations is provided from the Cavitette, a system for individual homes, to the Cavitator and the Spirahoff which is a primary treatment plant in one structure; or it may be used as a component of a complete plant. The Cavitator employs aerobic digestion and is available in prefabricated form in seven sizes in capacities of 2.000 to 7.500 gpd. Cavitator units are available in much larger sizes and are used in combination with one of the Yeomans clarifiers. The Spirahoff, employing the 2-story principle of settling and digestion provides for flows of 20,000 to 380,000 gpd. To meet the requirements of small commercial establishments, a new unit is offered in the 1,000 to 2,500 gpd capacity range. It is of the aerobic digestion type and consists of two mechanical aerators in series with a final settling tank, equipped with air-lift sludge return.

American Well Works-The Oxy-Pak is a factory built treatment plant utilizing total oxidation. There are some ten sizes available, serving populations of 10 to 25, for the smallest unit, up to 3,000. The three smallest sizes, for populations through 150, are complete units and include a steel tank; a minimum of erection construction is required. For populations in excess of 150, concrete tank structures are recommended. Various optional accessories are available. The smallest unit requires a space 10 ft. by 6 ft. and utilizes a one hp motor. Complete treatment is provided in one unit.

Municipal Service Co.—The "Suburbia" is not strictly a package plant in that predesigned and ready to install components of the plant are furnished for installation as small complete treatment plants. Population from 200 up to 10,000 can be served. The design provides primary settling in an Imhoff tank, fol-



Courtesy Dorr-Oliver Inc.

• BIOFILTRATION process is used in these two small plants serving an industry.



IMHOFF and trickling filter plant treats average flow of 42,000 gals./day.

lowed by treatment on a trickling filter and final sedimentation. Initial expenditure is low and under some conditions, part or all of the plant is salvable. A special feature of these plants is that their use permits very quick construction. A complete plant can be put in service in 120 days or less. Another feature of this plant is that it is furnished and installed only on a "turnkey" basis, Suburbia furnishes all necessary equipment and construction services, working in full cooperation with the consulting engineer. The design can provide progressive treatment, starting with an Imhoff tank and adding a filter and final tank, as needed; or the plant can be doubled or tripled in capac-

Walker Process Equipment Co.— The "Aeroburn" is a package plant based on the activated sludge process. The "Sparjair" is a contact stabilization package plant, also utilizing aeration. The former unit is made in four sizes, to serve 50, 100, 150 or 200 people; the latter is designed for 200 to 5,000 population and is made in 11 sizes. A screen or comminutor and other accessories may be provided. The Aeroburn utilizes the 24-hour aerobic diges-

tion method and the manufacturer states the effluent "is entirely inoffensive and may be discharged into any waterway without nuisance." The Sparjair is designed for harderto-treat sewages and where a crystal clear effluent is required. Walker also furnishes the Sparj-Pac which is a trickling filter plant using Dowpac media. The Aeroburn has a built-in system for foam control, utilizing a water spray. The general plan of this unit employs rectangular aeration and final tanks and a cylindrical sludge holding tank. A grinder may be installed in place of the screen. In sizes through 200 population equivalent, the Aeroburn is portable and may be trucked to the plant site completely assembled and ready to connect and operate. Other and larger units are sub-assembled for bolting or welding.

Smith & Loveless, Inc.—The total oxidation principle is employed in the Oxigest, which is a factory built unit available in five sizes to serve from 40 to 140 persons, A unit can be placed in service in about one day, delivery being made on special low-body trucks to the job site. Aeration tank capacities in the A models range from 4,000 to 16,950

gallons and shipping weights are 10,-700 to 20,700 lbs. In the B models, aeration tank capacities range from 15,000 to 34,700 gals. The A models are constructed in one piece; the B models in two pieces. Multiple units may be installed. Many accessories are available, including foam control; comminution; sludge storage; chlorinator housing, hypochlorinator and contact tank; and weir.

American Schreiber Co.-Treatment systems are of prefabricated concrete components. These may utilize septic or Imhoff tanks for sedimentation followed by trickling filters. The multiple septic tank systems provide holding capacity of 400 to 55,000 gallons; the Imhoff system can serve 25 to 1,200 persons; the compact plant is designed in a number of sizes for 120 to 15,000 population. In this, high rate trickling filters are mounted over the settling tank and recirculation is provided. Trickling filter units from 8 to 80 ft. in diameter are possible with the prefabricated components.

Fabricated Equipment Co.—This firm furnishes completely assembled plants utilizing aerobic digestion. These plants are made in 20 sizes from 1,000 gpd to 20,000 gpd and are shipped as a complete unit, with wiring and connections in place. The tank is of steel plate which is set on a concrete pad. Weights range from 3,000 pounds for the 1,000 gpd unit to 17,500 pounds for the 20,000 gpd plant. Froth control is provided. Atmospheric air is applied by a blower through tubular diffusers.

Komline-Sanderson used the total oxidation process in a prefabricated plant designed to serve populations up to 5,000. Aeration is by compressed air and aeration and settling tanks are integral. Schmieg Industries has announced a package plant on which data are not immediately available. Hays Process utilizes the contact aeration method for designs to serve 10 to 400 persons.

● MOTEL installation in Florida treats 25,000 gals./day.



INSTALLATION of a plant to serve a housing development.



Photography AIDS MUNICIPAL FUNCTIONS

S ONE PICTURE really worth 1,000 words? It is, according to James McGaughey, personnel officer of Burlington, North Carolina. In fact, he says "10,000 words couldn't do as good a job in many areas of our municipal activities."

From recording construction progress on a sewage plant to interesting an out-of-town industrialist with attractive views of the city's recreational facilities, from showing location of broken water lines to giving recognition to faithful employees, photography has proved to be an invaluable aid to Mr. McGaughey since he came to Burlington in January, 1957. He believes that it has saved the city time and money that can never be adequately evaluated.

The Personnel Office uses a 2½ x 2½ twin-lens reflex as its photographic workhorse. In addition, a 16 mm movie camera was added and is used for the preparation of training, documentary and public information films. The Police Department's 4 x 5 press camera and a personally-owned 35 mm single lens reflex are used when needed. Accessories of various kinds including supplemental wide angle and telephoto lenses, light bar, floodlight stands, tripod and filters were added an item or two at a time.

Mr. McGaughey does most of the work from snapping the shutter to processing in a darkroom shared by



PHOTOGRAPHS can show the status of the work as of any given date, the equipment on the job and many other items of information of value for permanent record.

the Police Department and the Personnel Office. Recently a new and larger darkroom has been outfitted in the municipal building and some processing of color slides and prints has been started. For reasons of economy certain improvisations, such as temperature controls, have been needed in these facilities. Temperature controls are more critical in color processing than black and white, and are still somewhat inadequate. Nevertheless it has been

learned that a satisfactory beginning can be made without a large investment.

In his first venture in movie making, Mr. McGaughey produced a 1,600-foot reel showing construction on a new dam and lake which is to provide Burlington with an additional three billion gallons of water and seasonal recreational facilities. The first shots were taken of the area before any work was done. Others show construction progress.



 HAZARDS, whether actual or potential, can be pinpointed and corrected, as in the case of the man on the spreader.



 COMPLETION dates of certain stages of the work, along with pertinent details, can be shown by timely photographs.

Like nearly all cities, Burlington would like to have more industry and the photographs are a valuable promotional tool. The pictures of the new lake and dam have appeared in several publications and Burlington has received prominent recognition in each one. When an industrialist sees that he would have plenty of water, he is likely to consider Burlington as a place for a new plant. The new lake will contain more than three billion gallons of water and will serve as a secondary water supply. Recreation areas are to be built on the shores of the lake and skiing, boating, and fishing facilities will be available.

Safety Improved

The city is always seeking ways to improve safety conditions on the job. Shots are made of construction work being done by city employees. On a particular asphalt paving job, pictures of a worker operating the spreader gate on the back of a truck load of gravel showed that the operator was in a dangerous position. The pictures were studied and the situation quickly remedied by installing a foot brace and hand grip on the truck bed.

Another case involved an operator of an asphalt distributor. Pictures showed that the operator's clothes were saturated with asphalt. Right below him was a constant flame used to keep the asphalt hot. Realizing how dangerous the situation was, precautionary measures were taken at once.

Reporting work progress of city forces and contractors is a major job. Photographs of work progress are almost as good as having each council member visit the actual scene. Interest and support are maintained as officials can observe progress reports in a few minutes.

In a city like Burlington with a rapidly increasing population (now estimated at 35,000), traffic is a big problem. Photographs help solve many traffic problems in Burlington's approximately 12 square miles and are an invaluable aid in planning and in carrying out a long-range thoroughfare plan. Photographs showing hazards are presented to traffic officials for study and remedy. As a result of these pictures many potential trouble spots have been discovered and eliminated before any serious harm was done. Photographs also aid in decisions on street widening and sidewalks. Some street photos have helped to do away with blind corners and curves; others have revealed inadequate traffic signs.

Mr. McGaughey makes numerous pictures of the city fire department's intensive and continuous training program. On Wednesday afternoons the fire department engages in a "cold run." This is a drill conducted on the afternoon when most of the city's downtown stores are closed. The drill is carried out as if there were an actual fire. The trucks race to the imaginary fire and firemen perform the functions as they would under actual fire conditions. Photos are made of the hose layout, rescue operations and other activities during the exercise. Studying these photographs has helped firemen cope with actual firefighting and rescue operations, because each move has been pre-planned, coordinated and freed of lost motion. The "cold run" photographs show clearly where each man is and what he is doing. Mistakes are pointed out and possible improvements discussed. The photographs also are used during training of new firemen and in lectures to school assemblies and civic groups. Firemen make use of them to emphasize fire prevention.

A file of all pictures and a notebook in which the date and other pertinent information for each picture is recorded is kept by Mr. Mc-Gaughey. He also keeps color slides on file and records when, where and by whom each one was used. Many of the city officials use these slides in illustrated lectures to civic and school groups. The record of each lecture prevents duplications.

Repairs Facilitated

Finding valves and breaks in underground water pipes is facilitated by photographs made of the lines as they are being laid. Each fitting and valve can be detected with the minimum of trouble and time. Photos made during the pipe laying also record construction progress.

An example of the value of photographs in recording construction data occurred recently when a new sewer outfall line was washed out during unusually heavy rains. After viewing the photographic evidence, city officials and the contractor were able to agree quickly on the repairs and adjustments necessary.

Before the new city lake and dam work began, Mr. McGaughey presented the council with a movie of the area and several photos. He also furnished the state highway department with photos of bridges and highways that would have to be removed or modified because of the lake construction.

Pictures of flooded areas help a great deal in establishing preven-





 BEFORE and after views record improvements resulting from reconstruction and straightening of this street.

tive measures. Recently a bad flood washed out several bridges. Debris covered much of the low land. Pictures of these conditions were made for future reference and study of what could be done to prevent further flooding. The pictures showed the flood level long after the water had receded.

In complaints and claims against the city because of injury or property damage, pictures have proved to be very helpful in telling the true story. Accidents with personal injury sometimes are taken to court and the photo plays a large part in pinpointing what or who is to blame.

Mr. McGaughey's picture snapping doesn't end at 5 p.m. He makes "after-hours" pictures of firemen fighting fires, traffic accidents and other activities. Sometimes he makes photos of street cleaning and, during winter, snow removal. He might snap a picture of a policeman walking his beat and checking store doors. He might make a picture of what firemen do at the station. All this helps acquaint the citizens of Burlington with what its city is doing when these pictures appear in brochures and magazines.

According to Mr. McGaughey, it is not necessary for a city to make a large investment in order to begin to benefit from photography. A twin lens 2½ x 2½ reflex camera and a roll of film are the basic tools. A satisfactory twin lens reflex camera can be purchased for approximately \$100 to \$125, and other pieces of equipment can be added as the need arises and funds are available.



PIPELINE consisted of 32-ft. double sections, individually lowered from a barge to the floor of the Niagara River.

TOUGH, pipe laying problems were solved in placing the final cross-Niagara River section of pipe which will soon supply drinking water to towns in Niagara County, N. Y.

The underwater pipe section is part of the \$10,000,000 Niagara County Water District System. This takes raw water from the west branch of the Niagara River and pumps it across Grand Island and the east branch of the river to a treatment plant. After treatment, the wa'er will be distributed through 65 miles of smaller lines to all 12 towns in Niagara County, plus several villages in Orleans and Erie Counties.

Laying the 2800-ft pipeline across the bottom of Niagara River's east branch proved especially difficult for three major reasons: 1) The 8-mile an hour (plus) current at the crossing site, about 5 miles above the Falls; 2) the depth of the river, 24 to 30 ft. most of the way; and 3) the rock like river bottom into which the pipe trench had to be cut.

W. L. Hailey Co., Nashville, Tennessee, had the \$1.25 million underwater pipe laying contract which also included the intake crib on the west branch, a pumping station and the pipeline across Grand Island. Except for the underwater work, most of this contract was completed early in 1960. Despite delays in the river crossing work, due to difficult conditions, the line was completed in December. 1960.

The Hailey organization called in maritime experts, the L. A. Wells Construction of Cleveland, Ohio, to construct the underwater portion of the contract with their highly specialized marine equipment.

The trench for the pipe was dug out of the river bottom by a 5-yard steam operated dipper dredge. The dredge was anchored lengthwise astride the line of the pipe crossing which was marked by targets on both river banks. A trench 20 ft. wide, and ranging from 7 to 16 ft. deep was cut. As the cut advanced, the dredge "walked" ahead on its spuds (anchor lines) by its own steam operated crowding engines.

Nearly 65 percent of the trench was cut out of material so solidly compacted that it was like rock. Spoil was deposited downstream of the trench, to avoid silting back into it. Two five-man crews dredged 16 hours a day, at times under flood-lights, and stayed several hundred feet ahead of the pipe laying crews.

Pipe Laying Barge

The pipe was laid from a barge 44 ft. wide and 165 ft. long on which was mounted a McMeillar 70-ton steam operated crane. The barge was anchored lengthwise in the stream and at right angles to the pipe line, and up river of the trench. Thus the actual laying of the pipe sections was always on the down river end of the barge, and there was no danger of men or material being swept into it. The barge was moved sideways across the river, winching itself on its four anchor lines (one at each corner) by the steam operated deck engines.

The wire fabric-reinforced concrete pipe was designed to resist internal hydrostatic pressures of 45 psi and for trench loading conditions equivalent to those for ASTM culvert pipe. The pipe was delivered to the river site in 16-ft. sections; inside diameter was 42 ins., outside 51 ins. The joints are of steel bell-

and-spigot type rings with 0-ring rubber gaskets, providing a leak-

proof joint.

The pipe-laying crew placed the pipe two sections at a time. Five double pipe sections were stocked on the aft deck of the barge, each day, with four or five of these 32-ft. lengths being laid in a typical 11 or 12-hour day. Pipe laying was done only in daylight hours and had to be suspended when the wind was strong, or when fog prevented checking the targets on shore for alinement.

Key to the success in laying pipe in a fast running river was experience, organization and teamwork. The pivotal man, the diver, who alone did the actual underwater installing work, never lacked for material or tools. Efficient organization of material prior to laying contributed to saving the diver time. First, the joints between each double section of pipe were secured by lug-and-bolt connections. Composite concrete-wood base blocks. about a foot wide and 41/2 ft. long. were provided to support each joint of the pipe line and triangular wooden chocks were fastened to the pipe to be wedged between the pipe and the wooden base block to insure proper grade. With the 32-ft. double pipe section and accessory material assembled, the crane picked up the pipe aft, swung it out over the water, completed a 180 degree swing, and eased the pipe into the water.

Diver Directs Operation

With the double pipe section nearly on the bottom, the diver took charge, utilizing two-way telephonic communication to coordinate all activities. The diver had to do everything by feel and from experience. He placed the composite concrete-wood base blocks across the trench, under the pipe at the joints. Next, he "talked" the pipe section down approximately level wi'h the previously placed section and made a loose connection between the new and the old pipe. Then he directed the pipe to be lowered completely onto the blocks. The pipe position was measured with a sounding pole, a device for checking the level of the pipe. The open curved end of the sounding pole was fitted over the top of the pipe. From water level markings on the pole, knowing the water level of the river, from a permanent gauge on the river bank, and knowing the required elevation of the pipe at that particular point, the foreman could relay to the diver



● FOREMAN on barge holds a red on top of pipe being positioned by diver while checking horizontal alinement by sighting on a target on river bank.

below whether the pipe was high, low, or on grade. Also, by checking the onshore targets of the pipe crossing line, the foreman could correct any horizontal deviation in

the line of the pipe.

To prevent silt and debris from washing into the uncompleted line, a bulkhead was placed over the leading end of the last double pipe section to be placed each day. Before backfilling, two other pipe lines were also placed in the same trench by the pipe layers. For a distance of 600 feet from the east shore of the river, a 36-inch reinforced concrete pipe was placed as an outfall for wash water from the treatment plant. For the entire crossing, a 16-inch steel pipe went into the trench, to carry treated water back to Grand Island.

Primary backfill of the trench, over all three lines, consisted of No. 2 washed slag, passing one-half inch, up to one inch. This backfill



 MAKING the pipe. The inner cage of reinforcing is being lowered into a form for casting 42-inch concrete pipe.

was required for the lower half diameter; the rest of the fill was the material excavated from the trench itself.

The pipe for the project was manufactured in the Rochester plant of American-Marietta Company and was trucked to the river edge site. Double cages of 2 x 8-1/6 welded wire fabric were used for pipe reinforcement. Concrete for the pipe was specified as testing to 4500 psi in 28 days, but under American-Marietta's strict plant control, this strength generally was reached in 7 days. Curing was by live steam inside the pipe sections for 36 hours, and 7 days in the yard before trucking to the site.

The District System

The Niagara County Water District in effect goes back to 1949 when the idea for a water system to encourage suburban growth, attract industry and relieve the general lack of good water supply was first developed. The Northwestern New York Water Authority developed this idea into a workable plan and in 1958 had plans and specifications completed. Charles H. Sells of New York and Leon H. Wendel, Lockport, New York Consulting engineer did the original work for the Northwestern New York Water Authority.

When the Authority was unable to proceed, the Niagara County Water District was formed to construct and operate the system, within Niagara County, as proposed. An administrative board composed of nine supervisors was appointed with Bruce J. Welton as chairman. Anthony L. Pusateri was retained as consulting engineer to supervise construction of the 11 contracts comprising the entire project.

Niagara County Water District's 12-mgd treatment plant, another major part of the project, soon will be ready to handle the water from the new river crossing pipe line. To relieve certain more critically water short areas in Niagara County, the Water District is already putting part of its distribution system in use, by buying water from the City of Niagara Falls.

The consulting engineering firm of McNamee, Porter & Seeley, Ann Arbor, Michigan, were retained by Mr. Wendel for construction supervision of the project (contracts 2 and 3). Paul Lundborg was the M.P.S. resident engineer, and Grant Fraser, his assistant. Guido Pierpaoli was superintendent for the L. A. Wells, Inc.

PLANNED MAINTENANCE Knows No Off Season

EDWARD D. REILLY

Associate Engineer,
Maryland State Roads Commission,
Baltimore, Maryland

M ODERN HIGHWAY develop-ment has changed maintenance from an arduous job of filling pot holes and digging ditches to an operation requiring a working knowledge of all the latest material and equipment advancements and a carefully scheduled sequence of operations. Although a vast highway construction program is being carried on throughout the country. the old road system is being called upon to carry traffic volumes far in excess of its original design capacity. It is the responsibility of the Maintenance Division to maintain (and at times perform major renovations) to this old system as well as to maintain the new highways in top condition.

To perform this dual operation effectively and efficiently, the establishment of a program of maintenance is imperative. The maintenance department must continuously survey the roads under its jurisdiction. Special attention is given to the road surface and to conditions that may require operations such as mud-jacking, bituminous sub-sealing, heater-planing or resurfacing. Maintenance operations are then scheduled by the season.

Spring Schedule

All asphalt surfaced highways are closely inspected for failures and cracking. Temporary patches placed during the winter are removed and replaced with permanent patches and all cracks sealed. In making a patch, the failed area is squared off and cleaned of any loose debris or dirt prior to placing the patch material. After the patch has been placed the periphery of the area is sealed. Patches are left slightly high to allow for compaction by traffic. After patching has been completed,

surface treatment work can begin. This is probably the largest single operation to be performed in the spring and is carried to completion once started. Joints in concrete pavements are poured and spalled areas and edge breaks repaired. Joints poured at this time are left a little low to allow for expansion.

In the spring of the year shoulders are still moist and can be worked without danger of the fines being dispersed in the wind. Snow fence and snow guide stakes are removed and stored. Drainage facilities are cleaned and inspected. Center line and edge line painting can be started as soon as weather permits and continued until fall.

Summer Projects

For aesthetics, assurance of proper drainage and fire protection, grass mowing is a major activity along the right of way. The hot period of the year is the most suitable for the use of the heater-planer on rippled or corrugated asphalt surfaces. Patching of concrete pavements and structures using epoxy resins usually gives the best results during

this season also. Preventive maintenance and repair of winter equipment is another important job.

Fall Program

Because the base material of the highway has had opportunity to solidify over the summer months, the fall of the year is the best time for sub-sealing and mud-jacking work. Road surface patching and joints sealing are continued. Joints sealed during the fall are left high to allow for contraction of the pavement.

As in the spring, the shoulders contain moisture at this time of year and can be worked and shaped without fear of losing the fines. Through the summer months and subsequent to the trees losing their foliage, small drainage structures, such as inlets and flumes, collect a deposit of debris and litter which is cleaned to facilitate proper drainage throughout the winter. Preventive maintenance and repairs are made to summer equipment prior to storage.

In the late fall season, prior to the first snow, all snow fence and snow



MODERN highway design often results in the creation of wide open spaces with the necessity for extensive mower operations. This view shows a rotary mower at work.

guide stakes are erected and snow removal equipment is placed in ready condition.

Winter Work

The prime operation throughout the winter season is snow and ice removal. This is an unpredictable activity that cannot be scheduled, but preparations, such as briefing the crews and establishing patrol routes and sequence of operation, should have been complete by this

Tree trimming to assure vertical and horizontal clearance can best be performed during the winter when the trees have lost their foliage and manpower is not committed to other activities. In most cases, it is necessary to repair road failures with a temporary patch during the winter season. These are then removed and replaced with permanent patches in the spring prior to scheduled surface treatment.

Maintenance of signs, guard rail and similar procedures are performed on a year-round basis as the need arises. Projects such as the construction of left turn storage lanes to eliminate traffic congestion at busy intersections; construction of shoulders adjacent to a narrow highway to facilitate increased traffic volume; and reconstruction of drainage facilities to accommodate additional storm water run-off, fall within the realm of the maintenance division and are scheduled according to need and availability of funds.

Complete and current equipment records are essential to an efficient operation. Data such as hours of usage, operational cost, mileage, etc., are compiled on each piece of



NTER storms are unpredictable, but require advance planning and preparation.

equipment. Passenger cars, trucks and pick-ups are replaced systematically. Passenger car replacement is based on the age of the automobile, about 25 percent of the fleet being replaced annually. Trucks, pickups and other equipment are replaced according to condition and availability of funds. Passenger cars and pick-ups are usually purchased as standard assembled items. However, special specifications for trucks, graders and major equipment are developed by the equipment engineer. Such specifications are usually based on the need for multi-duty operations such as snow removal, salt spreading and other specialized operations in addition to normal usage.

Materials to be used in maintenance projects must conform to the same specifications established by the department for contract construction work. Materials requirements are established well in advance so that materials can be purchased and placed in stock until needed. Districts submit material requisitions to the main office for review and summation: if the requisitions are in order, they are forwarded to the central purchasing agency where they are advertised for bids.

To assure uniform maintenance procedures throughout the state, the central administration division has prepared a Manual of Maintenance Procedures for district use.



• CENTERLINING and allied work is started as soon as



• HEATER-PLANER operations to correct rippled or corruweather permits and is continued throughout summer months. gated surfaces, a warm weather job, are done in the summer.

THE MIGRATION OF FLY LARVAE FROM REFUSE CONTAINERS VS. FREQUENCY OF COLLECTION

THE NOVEMBER, 1960, issue of Public Works carried a staff report on the extent of use of home food waste disposers and local regulations regarding their use. Among the responses the article evoked was a letter from Ralph J. Black, formerly Senior Vector Control Specialist, California Department of Health, now with USPHS, which is quoted in part as follows:

"Your November issue, containing the results of your study of the use of home food waste disposers, should help to resolve some of the questions frequently raised concerning their use. However, one of the important aspects of this problem that seems to have been overlooked is that of fly production.

"In California, and other places with a long fly production season, the reduction in fly production that occurs with the use of home food waste disposers is worth considering. An article in California Vector Views gives an account of an investigation undertaken at Concord, California. You will notice that an average of 1,128 larvae per can per week were found to migrate from the refuse cans to pupate before the refuse was collected. Three alternative methods of controlling the garbage can fly problem were given. They are: (1) to establish twice-a-week community-wide collection of mixed refuse, (2) to require each householder to drain and securely wrap garbage in at least three thicknesses of newspaper, or (3) to require each householder to install and use a garbage grinder.

"Since garbage must now be cooked to control vesicular exanthema before it is fed to hogs, the sale of garbage for hog feeding is much less profitable for California cities. One possible method of reducing costs is to combine it with other refuse and collect it only once a week (instead of collecting it separately twice a week). An important drawback to reducing the frequency of refuse collection is increased fly production. However, since a saving of approximately \$3.00 per person per year can be made with weekly collection, reduced fly production must be clearly demonstrable in order to justify the added expense of twice a week collection. A garbage can fly production investigation is currently being conducted in Pasadena to answer this question. This investigation is a cooperative project involving the City of Pasadena's Department of Public Works and Public Health, and this Bureau."

The article referred to was written by Ernest Campbell, Manager, Contra Costa Mosquito Abatement District and by Mr. Black. A somewhat condensed version appears below.

THE NECESSITY for investigating refuse containers as a possible source of flies at Concord arose as the result of adult fly populations that could not be correlated with expected sources within reasonable flight range of the city and a lack of specific published information. Also, field observations showed that fly larvae could be found in over 60 percent of the cans, and pupae or pupal cases in the ground near most refuse containers which were emptied each week. Backyard carry

service is provided in this residential community by a franchised private refuse collector.

All of central Contra Costa County east of the Berkeley-Richmond hills is included within the 509 square mile Contra Costa Mosquito Abatement District. Fly nuisances in the Concord area prompted Concord residents to form a citizens committee to investigate ways of controlling flies. It soon became apparent that the fly problem was general throughout the area, and the

existing District was the logical agency to perform the fly control work on an area-wide basis. Resolutions from civic groups petitioning the district to provide fly control were presented to the District's Board of Trustees. This responsibility was added to the district's traditional mosquito control program in 1955. So far as is known, the district became the first public agency, operating on a direct tax for specific purposes in a specific area, to engage in a sustained intensive fly control program.

Method of Investigation

A simple method was developed for investigating the problem of larval migration. Equal amounts of dry sand and sawdust were screened and then mixed to provide an easily handled pupation medium. Approximately three inches of this sand and sawdust mixture were placed in the bottom of open fiber drums, which were about six inches larger in diameter than the 30 gallon garbage cans used to store mixed refuse. The drums were painted so that their appearance would not be objectionable to the cooperating householder. The refuse containers of 30 representative householders, who were willing to cooperate, were selected for study. Two short lengths of board (2 x 4 inches) were placed on the sand and sawdust mixture to support the garbage can and keep it centered in the drum. The garbage can was then placed in the drum, the garbage can cover replaced, and used in the usual manner by the householder. Thus, any fly larvae which crawled out of the garbage can to pupate found a satisfactory pupation medium in the drum.

Two small transfer containers were used for collecting the fly larvae and pupae. First the garbage can and supporting boards were removed, and then the mixture of sand and sawdust containing the larvae and pupae was emptied into one of the transfer containers. Next, an identifying label with date and address was placed in the transfer container. A fresh batch of sand and sawdust was then dumped into the drum from the second transfer con-

tainer, and the supporting boards and the garbage can replaced.

The fly larvae and pupae were separated, counted and identified at the district's headquarters. A simple shaker screen was effectively used to separate quickly the larvae and pupae from the sand and sawdust. After a few shakes, the larvae were dumped from the screen into a metal pan 2 feet 4 inches square with 2-inch high sides. One-pint cardboard cartons were placed under the holes in each corner of the plan. In trying to get away from light, the larvae quickly crawled to the sides of the pan and then followed the side to one of the corners, where they dropped through the one-inch holes into the pint cartons. The pupae were gathered with forceps. Both larvae and pupae were preserved in alcohol for easy handling during identification and tabulation.

Results of 1957 Studies

A total of 67,407 larvae and 5,702 pupae were found in 185 specimen collections made from the 31 cans studied between September 7th and October 9th. This was equivalent to an average count of 731 larvae and pupae per can per week. The maximum count was 23,208 per can per week. When these results were arranged according to the length of time since the last refuse collection, it was found that only 3.2 percent of the migrating larvae left the garbage cans during the first four days of the week. Thus, 96.8 percent of the larvae migrated from the garbage cans during the last three days of the week.

Results of 1958 Studies

It had been planned to start early in the 1958 season with the hope of finding out when the migration of larvae occurs as well as the extent to which it occurs. However, unusual and continuous rains would have made recovery of larvae from the wet sand and sawdust difficult, and the pressure of mosquito control needs contributed to delaying the studies until after migration had started. Between June 7th and October 20th, a total of 378,889 larvae and 40,814 pupae were found in 697 specimen collections from 30 cans. This was equivalent to an average count of 1,131 larvae and pupae per can per week. The maximum count was 19,614 per can per week. When the results were arranged according to the length of time since the last refuse collection, it was found that only 10.6 percent of the larvae left the garbage cans during the first four days of the week. Thus, 89.4

percent of the larvae migrated from the garbage cans during the last three days of the week, which was approximately the same as the 1957 results.

Since early findings in the 1958 studies suggested that counts would be high, it was decided to test the effects of the addition of PDB (paradichlorobenzene) and naphthalene to the garbage cans. In both cases these materials were attached to the garbage can lids. Two ounces of PDB, in either crystal or nugget form, were placed in a piece of folded screen which was attached to the lid with a cotter pin. The oneounce naphthalene wafers were attached to the lid with the wires provided.

In the PDB studies, a total of 26,-980 larvae and 2,255 pupae were found in 110 specimen collections made from the 25 cans studied between August 29th and October 9th. This was equivalent to an average count of 472 larvae and pupae per can per week. The maximum count was 6,358 per can per week. Almost all 98.6 percent of the larvae migrated from the garbage cans during the last three days of the week. These results indicate that PDB had little effect in preventing fly production.

In the naphthalene studies, a total of 116,602 larvae and 18,995 pupae were found in 80 specimen collections made from the 15 cans studied between August 11th and September 3rd. This was equivalent to an average count of 2,712 larvae and pupae per can per week. The maximum count was 31,880 per can per week. During the last three days of the week, 93.2 percent of the larvae left the garbage cans. These results indicate that napthalene had no effect in preventing fly production.

Discussion

The results show that large numbers of larvae migrated from the refuse cans to pupate before the refuse was collected. An average of 1,128 larvae per can per week were found during the two years of study, which included a total of 583 weekly observations. Over 99 percent of the larvae collected were Phaenicia, probably P. sericata, but a few specimens of Fannia, Muscina, and Sarcophaga species were also collected.

By collecting two specimens each week from each can, it was found that from 89.4 to 98.6 percent of the larvae left the garbage cans during the last three days of the week. The question of how 1.4 to 10.6 percent of the larvae were able to develop



 FIRST STEP: Garbage can is placed in a fiber drum containing sand and sawdust to provide pupation medium.



SECOND: Sand-sawdust mixture containing larvae and pupae is collected.



● THIRD: Shaker screen is used to separate larvae and pupae from mixture.

and migrate during the first four days could be answered by the fact that oviposition could have occurred either (a) on the first day the refuse was placed in the can; (b) before the refuse was placed in the can; or (c) the larvae could have been left in the bottom sludge of



 PROPER wrapping of household refuse can be a big factor in fly control.

the garbage can when the refuse was collected.

The 1st to 4th day specimen collections were made when there was some refuse in the can, so that it was impossible to determine what was responsible for the apparent rapid development and migration of a small number of larvae during the first four days of the week. However, on a few occasions some bottom sludge was observed in which fly larvae were present. Since the main purpose of this investigation was to determine how many larvae migrate from garbage cans, it was decided to avoid making additional observations which might result in the cooperating householders becoming self-conscious and changing their practices of garbage storage.

When the average counts of fly larvae and pupae per can per week were compared with the average daily maximum temperature by week, a good correlation was found. This would indicate that even though there are probably other factors which affect this migration, a high daily maximum temperature is apparently the most important. From a practical standpoint, this would suggest that the period when twice a week refuse collection was necessary might be determined directly from the average daily temperature records. The results indicate that when the average daily maximum temperature by week reaches 75°F., twice-a-week collections should be started at Concord.

The counts varied widely, so that in any week-one third of the cans accounted for 90 percent of the total count. On the other hand, one-third of the cans produced five or less larvae per can. Of interest was the fact that two cans had consistently low counts (a total of 19 from each can for the entire season) apparently because one household used a gar-

bage grinder and the other always wrapped all garbage in newspaper.

With a warm climate as is found in central Contra Costa County, three alternative methods of controlling the garbage can fly problem appear to be feasible. They are: 1) to establish twice-a-week community-wide collection of mixed refuse; 2) to require each householder to drain and securely wrap garbage in at least three thicknesses of newspaper; or 3) to require each householder to install and use a garbage grinder. This study showed that with twice-a-week collection. the refuse would be removed before larval migration of any consequence occurs. Because of local conditions, the other two alternatives were not studied, although they are commonly used in other places to prevent fly production in refuse.

From a practical standpoint, the establishment of twice-a-week refuse collection during warm weather would increase collection costs, but would give results quickly without special effort on the part of each householder. Although there is little expense involved in wrapping garbage with newspaper, it has been difficult to achieve on a communitywide basis. While garbage grinders are generally purchased because of the increased convenience to the housewife, few sales are apparently based on fly control. Moreover, garbage grinders increase the load on the sewerage system and the sewage treatment plant, which is undesirable in some communities. Therefore, the selection of the best alternative for any community will depend on the evaluation of local conditions.

Ductile Iron in Highway Construction

THE USE of tough, corrosion resistant ductile iron as coverings and gratings in streets and highways is gaining favor among construction engineers. For these applications, material requirements call for the corrosion resistance of cast iron, the strength of steel and a configuration which will provide a consistent fit that eliminates noise caused by the passage of traffic over the cover.

Consolidated Edison Co., which distributes electricity in New York City, selected cast ductile iron gratings to form the roof of transformer vaults located beneath busy streets. This selection followed studies made in the foundry and testing labor-

atories of Crompton & Knowles Corp., Worcester, Mass., where in addition to testing specimens for physical properties, the company's engineers conducted radiographic inspections of castings as specified by Consolidated Edison.

Another project where ductile iron gratings were utilized was the 130-mile long Massachusetts Turnpike. Approximately 4000 gratings were installed as part of the storm water drainage facilities for the Turnpike. Each grating is set in a metal frame and fits securely so that no noise is created by passing traffic. It is said that since 1956 there have been no broken grating.



GRATINGS of ductile iron for a drainage system on the Massachusetts Turnpike.

SMALL SIZE PIPE for Sanitary Sewers

A STUDY of the use of small size pipe for sanitary sewers has been made by a special advisory committee of the Building Research Advisory Board, Division of Engineering and Industrial Research, for the Federal Housing Administration. The study covered the acceptable minimum size of pipe that should be permitted for sanitary lateral sewer use in residential areas; the conditions attached to the use of such pipe, if acceptable; and recommendations in respect to design, construction and maintenance practices.

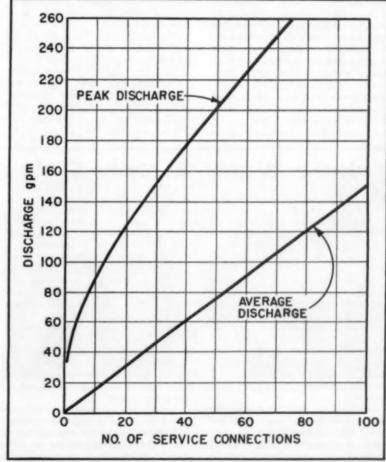
The hydraulic design of a sewer is based on the service load, which may include, in addition to normal sewage flows, contributions from gravity basement floor drains, roof leaders, footing drains, infiltration and extensions which may or may not have been foreseen. Also, according to the current national trend water consumption is expected to continue to rise and stoppages in smaller sewers are considered to be more likely. Weight should be given to all these factors when designing a sewer line.

The committee recommended a minimum size of 6 inches, stating that "it is apparent that the 6-in. size will be suitable only in a limited number of cases where it is clear that few houses will be served. that upstream extensions are improbable and that additional loads will not exceed sewer capacity." A minimum velocity of 2 feet per second, based on design flow, was recommended. In the upper ends of laterals, the sewer may flow less than half full. In such cases, the velocity should be maintained by increasing the slope wherever possible. Uniform grade and alinement should be maintained between manholes. When lines of different sizes are connected, the connections should be designed so there is never a back-water effect from the larger or more heavily loaded sewer.

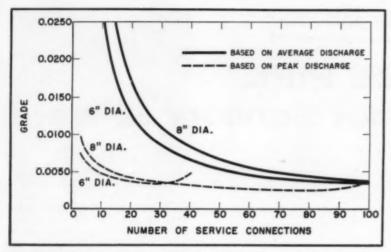
Some special studies are needed. One is on actual depths of flow in 6-in. and 8-in. lines in residential areas to establish relationships between actual and estimated peaks and valleys of flow; and to indicate velocity. Egg shell deposits are possible and this problem requires research to determine the velocity necessary to move them. The effects of detergents, grease and grit may also be important.

Present-day residential site planning has a significant effect on the design and layout of sanitary sewer systems. Motor traffic congestion has been primarily responsible for increasing departures from repetitive gridiron street patterns. The use of dead-end, cul-de-sac, and curving streets discourages through

traffic from entering residential access streets. Planning of this kind reduces the likelihood that these areas will be rezoned because of a change in character from residential to commercial or industrial. Thus, there is less need for new sewers to be overdesigned to accommodate new uses or possible extensions beyond terminal ends of sewer laterals. Although modern site planning cannot guarantee against future demands for increased loads on sewers, it reduces the guesswork concerning future needs. It remains true, however, as experience has



 ESTIMATED volume loadings on sewer laterals based on the number of service connections to the line and the peak and average discharges in gallons per minute.



• GRADES for 2 fps velocity in 6 and 8-in. lines, with peak and average flows.

shown, that where future extensions to a sewer line are anticipated, the original design should provide sufficient capacity for such expansion.

A survey was made to obtain information on the use of small-size pipe; 261 replies were received. Of 47 State Departments of Health 13 permitted 6-in. pipe under certain conditions; 6 others permitted 6-in., apparently without reservation; 28 states did not permit or recommend its use. Of 197 replies from various agencies as to minimum size street sewer permitted, 102 required 8-in. while 95 permitted use of 6-in., 63 of them only under special conditions. Such conditions were

usually: no extension of line; limit on length or number of connections; steeper minimum grade; and closer manhole spacing. In regard to service experience, 56 replies indicated 6-in. pipe suffered more stoppages and required more maintenance, while 37 reported no noticeable differences.

Illustrations in the report, which is Publication 507 of the National Research Council, show clearly that, when using the Manning formula for uniform flow, with n=0.013, to maintain a given velocity under a given discharge, the required grade for an 8-in. pipe is greater than for a 6-in. pipe. Also, the relative depth

of flow is less for the 8-in. as long as the depth of flow in the 6-in, is less than about 0.8 of the diameter.

The appendix of the report contains a discussion of the hydraulics of small laterals by Robert S. Wyly. It emphasizes the minimal attention given to the problem of choosing a suitable combination of pipe diameter and grade to fit an existing situation. It is important that the choice result in a sewer lateral that is not overcharged at peak flows and not subject to velocities that are insufficient to be self-cleansing.

The volume rate of discharge to be provided for will lie between two extremes: 1) An assumed incremental value of 0.8 gpm per fixture unit of plumbing fixture load, based on the work of Hunter and 2) a value obtained from probability considerations, a discharge which probably will not be exceeded more than one percent of the time during "rush-hour" service. The discharge per service connection may be computed for 2-bath homes with automatic dishwashers, laundries and disposers using an assumption of 19 fixture units per home and 0.8 gpm per fixture unit. The average discharge curve in Figure 1 is the result of this computation. The peak discharge was estimated by the method given in the American Standard National Plumbing Code ASA A40.8 (1955). Hunter's evaluation is given in NBS Building Materials and S'ructures Report, BMS65 (1940).

Toledo Water Supply Data

THE following are from the excellent annual report of the Division of Water, Toledo, O., for 1959. Sol Wittenberg is Commissioner; Russell Rink is City Manager; and J. C. Webber is Chief Engineer.

Water service mains constructed in 1959 totaled 10,215 feet of 6-in. at an average cost of \$7.00 per foot and 4,741 feet of 12-in. at an average cost of \$11.02. These were all cast iron. The slip type joint, first used in 1959, has advantages of lower cost for materials and installation costs and lower leakage losses, especially under bad installation conditions.

Cross connections between the city water supply and well and river water are a continuing concern. A constant check is made to prevent any contamination of the city water supply in this way. Industries use well or river water in

many cases when potable water is not needed and direct connection between the two sources was common in the past; in the period from 1951 to 1953, of 291 installations inspected, 145 were found to have cross connections; from 1954 to 1956, of 67 installations inspected, 33 violations were discovered; and from 1957 to 1959 of 169 installations inspected, 6 violations were found. These data show that continuing inspection is required. Also all residences known to have had a well, previous to obtaining city water, are inspected to make certain that the two sources are not cross connected.

During the early part of February a break-up of ice, accompanied by flood levels, in the Maumee River brought turbidities of 700 mg/L in the raw water. Flood waters lowered the total hardness of raw water to a record low of 78

mg/L during this period. Foam from detergents was piled three feet thick on the water in the raw water flume, and the presence of detergent in the raw water made coagulation most difficult. Taste and odor conditions in the raw water were also severe at this time. These adverse conditions, which did not completely subside until well into March, were a prime factor in the increase of average cost of chemicals per million gallons treated from \$11.494 in 1958 to \$13.753 in

In May, a survey of the existing lime sludge lagoon capacity was made. This survey revealed that the present lagoon facilities will be filled by Spring of 1961. A study was started in July to determine the method of future sludge disposal in collaboration with the Engineering Bureau. The use of a continuous feed centrifuge on an experimental basis was begun in late November. The application of sludge to a centrifuge will be continued.



NEWS BULLETINS

AMERICAN PUBLIC WORKS ASSOCIATION, 1313 EAST 60th STREET, CHICAGO 37, ILLINOIS

The Latest Public Works Equipment To Be Displayed at APWA Congress

With over 80 percent of the exhibit space sold, plans for another highly successful Equipment Show at the 1961 Public Works Congress are rapidly taking shape. Over 72 firms furnishing equipment and supplies for the public works field have contracted for space at the annual meeting which will be held at the Municipal Auditorium, Minneapolis, Minn., September 24 through 27. While the sale of space has been progressing quite rapidly. some spaces are still available and it is still possible to accommodate a few more firms who are interested in exhibiting. Gordon E. Bodien, city engineer of Minneapolis, is serving as Chairman.

The exhibition facilities of the auditorium provide an excellent setting for an equipment display. Approximately 3,000 public works officials from the United States and Canada are expected to be on hand to see what is new and different in equipment and supplies. The Equipment Show, which is an important part of the Association's annual meeting, represents the most extensive display of this type of equipment anywhere in the Nation.

A great deal of careful planning will go into the technical sessions in an effort to present a wellrounded and thorough approach to many of today's problems in public works. Speakers and topics will be announced at a later date.

Located as it is, in an area of natural beauty, this cultural city of the upper midwest offers many interesting possibilities to the person who would like to combine his vacation plans with a trip to the Congress. The Twin City metropolitan population is over 1,200,000. Minneapolis is a city of lakes and parksthere are 152 parks, five municipal and eleven private golf courses, with 22 lakes within the city limits. It has many fine art galleries including the Minneapolis Institute of Arts and the Walker Art Center, and a Symphony Orchestra which is one of the top five in the nation. Minneapolis offers much to the sports enthusiast and is the fashion

headquarters for the upper midwest. It also offers the finest in restaurants and entertainment.

The Leamington will serve as the headquarters hotel for the four-day meeting. The following is a partial list of exhibitors who will be participating in the Equipment Show.

The American City Magazine American Pipe Cleaning Co. Arrow Safety Device Company Asplundh Chipper Co. Austin-Western, Constr. Equip.

Div., Baldwin-Lima-Hamilton Corp.
Caterpillar Tractor Co.
Chevrolet Motor Div., GMC
City Tank Corporation
The Cobey Corporation
Frederick H. Cone & Company
Combustion Engineering, Inc.



Municipal Auditorium in Minneapolis, site of the 1961 APWA Congress.

OFFICERS: Frederick W. Crane, Buffalo, N. Y., President; Albert G. Wyler, New Orleans, La., Vice President. REGIONAL DIRECTORS: (term ending 1961) Louis H. Moehr, Wyandotte, Mich.; John A. Morin, Oakland, Calif.; Roy W. Morse, Seattle, Wash.; (term ending 1962) Paul R. Screvane, New York, N. Y.; Manon P. Phillips, Augusta, Ga.; Edward J. Booth. Bismarck, N. D.; (term ending 1963) George J. Maher, Lewiston, Maine; Robert S. Hopson, Richmond, Va.; Harlan H. Hester, Fort Worth, Texas. Immediate Past President, Jean L. Vincenz, San Diego, California. Robert D. Bugher, Executive Director.

2 NEW FITCHBURG CHIPPER FEATURES



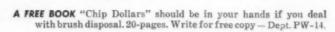
- 1 EXTRA PROTECTION for your crews with this NEW SAFETY STOP SWITCH that stops all moving parts of the chipper within seconds. Switch is within easy reach at rear so operator can flip it without moving from feed position. An important new feature of the Fitchburg Chipper, already considered safest because it has no hard-to-control flywheel.
- 2 GREATER ECONOMY with this NEW SOLENOID SWITCH* which allows the operator to quickly idle the motor between actual brush feedings. With the motor idling, you save on gasoline and engine wear; and there's less noise, which pleases the public. Your operator can use the switch easily because it is at the rear and handy.

CHIPPING IS SMOOTHER and faster with a Fitchburg because of its exclusive spring activated

feed plate. This patented feed plate "gives" automatically under pressure. You can chip even large limbs (up to rated capacity) without killing the engine. And your crews are safer because the feeding action is more positive, smoother, with less whipping of the brush.

CHIPPING IS MORE EFFICIENT with a Fitchburg. The exclusive feed plate allows wood to be chewed up in small bites. This takes less power, and the engine can be run at lower r.p.m.—which is more efficient, saves you gas and cuts engine wear.

TROUBLE-FREE Fitchburg Chippers stay out of your shop so you don't lose valuable man-hours. These rugged machines are the choice of tree surgeons, line clearance contractors and others—men who depend on Chippers day after day to make money. Blades are made from special alloy steel to hold a keen edge for a long time, even with hard use. Fitchburg Chippers are well-engineered, come in four sizes to meet your needs: the largest handle limbs as thick as seven inches with ease.



optional equipment

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Galion Products, Inc. Illinois Stoker Company Industrial Blow Pipe Company International Harvester Co. International Incinerators, Inc. International Salt Company Johns-Manville Lock Joint Pipe Company Massey-Ferguson, Ltd. M-B Corporation Minneapolis-Moline Co. Minnesota Mining & Mfg. Co. Mobil Sweeper Div., The Conveyor Co. Morse Boulger, Inc. Morton Salt Company Motorola Communications &

Electronics, Inc. Neenah Foundry Co. Newark Brush Company Nichols Engineering & Research Corp. O'Brien Manufacturing Corporation O'Cedar Div., American Marietta Co. O'Connor Transfer Systems, Inc. Pak-Mor Manufacturing Co. Plibrico Company Portland Cement Association Public Works Journal Corp. Refuse Removal Journal Refuse Disposal Equipment Co. Remington Rand, Univac Rynal Corporation Sanfax Corporation W. H. Stewart, Inc. Tarrant Manufacturing Co. Truck Equipment Corporation G. H. Tennant Company Tuffibre Company Wayne Manufacturing Co. E. B. & A. C. Whiting Company Wisconsin Motor Corporation Witch Marketing Company Wylie Manufacturing Co., Inc. Young Spring & Wire Corp., Equipment Div. Yale & Towne Mfg. Co.

APWA Honors Long-Time **Members**

the American Public Works Association has proudly presented to struction industry and discussed

six of its members Life Memberships in the Association. This recognition is given in acknowledgment of their long-time support of this organization.

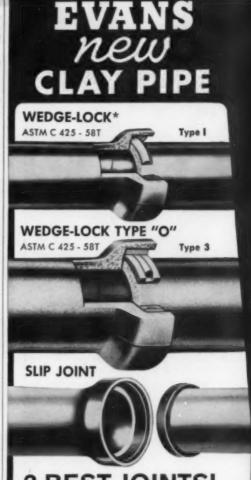
granted Life recently Those Memberships include: SAMUEL S. BAXTER, water commissioner, Philadelphia, Pa.; ERNEST R. BROOKS, engineer of surveys and plans, Bureau of Surveys and Design, Department of Streets, Philadelphia, Pa.; ALBERT W. Moser, chief, City Plans Division, Bureau of Survey and Design, Philadelphia, Pa.; ROBERT A. MITCHELL, chief engineer and traffic engineer, Wilmington, Del.; Russell S. Eschbach, Union, Mo.; James W. Morgan, Mayor, City of Birmingham, Alabama.

Life members are exempt from paying any annual service fees and retain the rights and privileges of their previous class of membership. Any individual who has been an active member for thirty years is eligible. Also, persons who have been active for a period of twenty years or more are eligible upon reaching the age of 70, or upon reaching the mandatory retirement age of the agency for whom they are employed; however, such individuals do not become a Life member until they reach the age of 65.

Southern California Chapter Joint Committee Starts Specification Project

A drive to raise \$25,000 for a proposed uniform public works specification program for Los Angeles City and County has been announced by a Joint Committee of the Southern California Chapters of APWA and the Associated General Contractors. Leading local engineering and construction industry officials heard the announcement during a luncheon to launch the program, which will be undertaken by an APWA-AGC Joint Committee and the principal city and county public works agencies.

Designed to save hundreds of thousands of dollars a year, the program seeks to establish one set of construction specifications for city and county jurisdictions. The general program was outlined by Silas B. Birch, assistant inspector of public works for the City of Los Angeles and Co-chairman of the Joint Committee, while Co-chairman S. A. Wattson, president of R. A. Wattson Company, Engineering Con-During the past several months tractors, stressed the importance of uniform specifications to the con-



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methods of financing the project. Wattson noted that the uniformity that would result from standardization of contract bidding forms and procedures, construction materials and other technical features would attract more bidders and, in turn, bring about economies in public works engineering construction.

Members of the APWA-AGC Joint Committee include J. Marvin Blair of the Los Angeles County Road Department; Lloyd Trousdale, Department of County Engineers; O. S. Kelso, Southern California Gas Company; C. D. Chase, Brown-Bevis Industrial Equipment Co.; Frank Randall, Pacific Telephone Company, Past President of the Chapter and District Representative; Donald E. Kelbey, Alex Robertson Co.; Alex Rados of Steve P. Rados Co.; Robert Van Valkenburgh of N. P. Van Valkenburgh and Sons; and Thomas L. Sweeney. City Bureau of Engineering.

APWA Chapters Plan Spring Meetings

Spring is a very active season for many of the 33 chapters which comprise the American Public Works Association. During the months of April and May, at least 11 APWA chapters have scheduled technical programs and special meetings either jointly or individually. These local chapter conferences provide one of the most fruitful sources for new ideas to local problems available to public works officials. In most instances the participants on the program are dealing with specific problems common to a particular area. It is through such formal presentations and informal discussions that many innovations are put into practice in the public works divisions of our local government. Check the list below for meetings in your area. All members are urged to take advantage of these opportunities and to take a friend.

Alabama Chapter
Date: May 4 and 5
Place: Montgomery, Ala.
Contact: Rex R. McGinnis, superintendent Paved Streets and Excavations, City Hall, Birmingham 4, Alabama

Joint Meeting of Illinois-Missouri Chapters Date: April 24 and 25

Place: St. Louis, Mo.
Contact: Herbert Poertner, public
works director, St. Louis
County, Courthouse, Clayton,
Mo.

Florida Chapter
Date: May 4, 5 and 6
Place: Sarasota, Florida
Contact: Gordon S. Burleson, di-

rector of engineering, P.O. Box 71, Orlando, Fla.

Michigan Chapter Date: April 27

Date: April 27
Place: Lansing, Michigan
Contact: Frederick A. Mammel,
superintendent of public works,
City Hall, Ann Arbor, Mich.

Joint Meeting of Ohio, Ind. & Ky. Chapters

Date: April 27 and 28
Place: Cincinnati, Ohio
Contact: W. C. Wichman, director,
Department of Public Works,
Cincinnati, Ohio

Upstate New York Chapter
Date: April 30th-May 2
Place: Schenectady - Rotterdam,

N.Y.
Contact: Fred A. Simone, Jr. engineering aide, Dept. of Engineering, Town Hall, Rotterdam

Va.-D.C.-Md. Chapters
Date: April 21 and 22
Place: Baltimore, Md.
Contact: Donald S. Frady, director, Dept. of Public Works, 151
East Broad St., Falls Church,

Va.

Wisconsin Chapter
Date: May 18 and 19
Place: LaCrosse, Wis.
Contact: John G. Thompson, city
engineer, Room 115, City—
County Bldg., Madison 9, Wis.

Central California Chapter Plans Inspector's School

The Central California Chapter of the APWA and the local chapter of the Engineering Grading Contractors Association are presently considering the possibility of sponsoring a training school for inspectors. As it is presently being organized, the course would consist of six 3-hour sessions which would review the intent of state specifications, field construction practices, concrete work, earth moving and excavations, asphaltic pavement and the various types of pipe line construction.

Through such a course the inspector can become more familiar with the intent of the contract documents which will lead to better communications and a mutual understanding between all persons involved, and consequently to a better job. The details for such a course have not been completed and further information will be made available later.



- DOUBLES PRODUCTION FOR ROAD CURBING

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- kept traffic lanes open
- replaced { one backhoe one grader one front-end loader
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HIGHWAY AND AIRPORT DIGEST



Prepared by L. G. BYRD, Associate Editor

Subgrade Drainage

Many pavement failures are attributable not primarily to poor subgrade drainage design, but to the existence, at the time of failure, of poor drainage conditions. These failures stem from the accepted fact that the load carrying ability of the subgrade decreases in proportion to the increase in moisture content above optimum. In addition to moisture leakage through the pavement and storm water absorbed and trapped by the shoulders, a water source that presents a serious threat to subgrades and pavements is the ground water absorbed by the subgrade from below the pavement. There are two general conditions in which ground water absorption is most likely to occur: First, where the water table is at an elevation higher than the profile of the road, water will be forced into the subgrade by hydrostatic pressure; second, where the ground water table lies just below the subgrade, capillary action, accentuated by the pounding action of traffic, will draw water up into the subgrade. Often these conditions combine to aggravate moisture problems.

"A Practical Approach to Subgrade Drainage, Part 1 of 2." By John M. Wilkerson, Jr., State Road Design Engineer, Georgia State Highway Department. Highway Magazine, February, 1961.

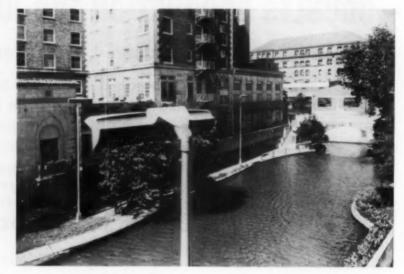
Striping Materials Tested

Painted traffic markings and lane lines have one characteristic that troubles traffic engineers—the tendency to lose much of their visibility and reflectivity when the pavement surface and the stripe are covered by a film of water. The Washington State Highway Department

has tried to overcome this problem by elevating the stripe above the pavement surface so water would drain off quickly. This scheme has proven impractical construction wise and requires constant maintenance. A better solution has been sought in a marking material having good reflective characteristics, surface life and flexibility and economy of installation. Test on permanenttype markers have been made by the highway department in cooperation with the City of Seattle and, more recently, by the department on a high-speed high-volume sec-

tion of U. S. 99 near Fife, Washington. Materials tested grouped in three classes: 1) Dome shaped, pre-formed buttons incorporating glass beads and designed to be cemented to the pavement-American - Marietta Corporation's "Lite Lane" markers was selected as a typical material of this class showing high quality characteristics: 2) thermo-plastic reflectorized material designed to be extruded on the surface at high termperature -Cataphote Corporation's "Catatherm" and Traffic Appliance Corporation's "Perma-Line" were se-

STREET LIGHTS BEAUTIFY A RIVER



S AN ANTONIO, Texas, has focused public attention on the beautiful San Antonio River, which winds through the center of the city, by lighting the river at night. Well landscaped banks and graceful bridges have made the river one of the city's major daytime attractions, but the beauty of the river was lost

at night because of a lack of light. The City Public Service Board decided to remedy the situation, so they installed Mainstreeter luminaires—Westinghouse refractor-type outdoor fluorescent lighting fixtures—along both sides of the stream. Now the San Antonio River is a "full-time" tourist attraction.



Michigan gets special boom... city gets low-cost pipe handling

With a unique boom fastened to its 1¼ yd bucket, a mobile Tractor Shovel is handling all pipe lifting and hauling chores for the City of Waterloo, Ontario, Canada.

Costs for this service have been cut substantially, and the need for an excavator crane has been eliminated.

The idea for the special boom was conceived by City Engineer, D. B. Dutton, shortly after the city acquired their Tractor Shovel—a 77 hp Model 75A Michigan! Handling of water and sewer pipe had always posed a problem . . . because it was an occasional job, the full-time crane was an unnecessary expense. However, noting the Michigan's exceptional stability and lift capacity (7,000 lbs), Mr. Dutton saw a way to cut costs both in the material yard and at the trenching site.

Long pipe no problem with Michigan stability

"We welded special brackets to the top of the Michigan's bucket to hold

a detachable 5 inch by 10 ft boom," reports Mr. Dutton. "Now, when there's a call for pipe, we simply drive the 26 mph Michigan over from one of its other jobs, attach the boom into a pipe . . . and drive away. The machine loads both heavy 24" x 6' concrete and 14" x 13' transite pipe in the yard, and unloads at the site."

Assignments include landfill garbage disposal

This same stability helps the torque-converter-drive Michigan perform a wide variety of other digging and loading assignments for the 16,500 people of Waterloo. For example, the machine travels everywhere under its own power to backfill sewer excavations. It truckloads asphalt, gravel and dirt from stockpiles. It removes stumps and trees. Loads broken concrete. Delivers pre-cast catch basin sections. Clears snow from streets. Loads salt and gravel

into spreader trucks. And it handles work on the city's two land reclamation and sanitary landfill projects.

"The Michigan is the most economical machine we've ever operated," Mr. Dutton points out. "After 19 months of five and six day week operations, there has been no downtime or major repairs."

You can expect similar economies when you buy a Michigan . . . plus the added bonus of a large selection of money-saving attachments—street sweepers (with or without sprinklers); backhoes; crane hooks; fork lifts; scarifiers; "V", straight and blower type snow plows; tree transplanters; tampers; a wide variety of buckets. See your Michigan Distributor for a no-obligation demonstration.

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Makes history by sawing 111/2" thick, 5000 lb. test concrete reinforced with 2 lavers of 1/2" rods on 8" centers. Big slab sawed out in 31/2 hrs.

PROJECT: Wind tunnel at government research base. CONTRACTOR: Nash Drilling Co., Ltd., Montreal, P.Q. EQUIPMENT: Truco 18 H.P. Economy Concrete Saw; Truco Tru-Bond Diamond Blade 26' dia. 3' thick. JOB: Cut an inspection opening 10'0' x 5'0' in 5000 lb. test concrete reinforced with 2 layers of reinforcing rods ½' dia., placed on 8' centers. Slab was marked off in two 5'x5' sections, and 3' holes drilled in the four corners of each section to receive fastenings for cables to support slabs. Four cuts released the first slab for removal. Three more cuts released the second slab. The 26' dia. Truco Diamond Saw made a 10½' cut and the remaining concrete on the wavy underside (about 1') easily broke away when the slab was lifted. Actual cutting time was only 3½ hours and the entire job was easily done in one day. Savings are so great Truco Diamond Drilling and Sawing Equipment may pay for itself on a single job or in a single day. Send for new Truco catalog. Truco catalog.

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lected for this group; and 3) flexible, linoleum-type material incorporating glass beads and having a pressure-sensitive adhesive backing-Prismo Safety Corporation's "Plastix' was chosen for this third classification. Department engineers are hopeful that the permanent types of markers will prove useful and practical in their marking programs.

"Modern Striping Methods Tested." By Lew Cody, Materials Division, Washington State Highway Department. Highway News, January-February, 1961.

Aerial Mapping

District 15 of the Texas Highway Department has, since 1958, initiated 25 aerial-mapping projects covering 309 miles at an average cost of \$1,015 per mile. The typical project covered aerial photography and preparation of 1:40 scale planimetric and topographic maps with spot elevations and a one-foot contour interval for a 1200-foot width. Aerial mosaics, useful in route location studies, have had limited value in planning improvements along existing highways. The aerial contractor panels a ground survey base line, established by District personnel, and uses it for all horizontal control in planimetric work. The Department requires that the contractor field edit each planimetric sheet to avoid errors such as those found on work performed during initial projects. Planimetric sheets are used as base maps for right of way, schematics and plan sheets. To avoid land title problems, property lines are field surveyed as are critical features in urban areas. In general, the District finds the use of aerial mapping saves time and expense in many phases of its

"How Good is Aerial Mapping?" By George S. Meyer, Supervising Resident Engineer, District 15, Texas Highway Department. Texas Highways, January, 1961.

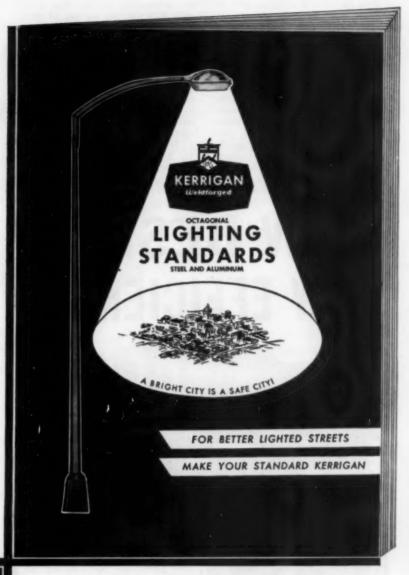
Soil Cement City Street

An experimental study of soil cement construction was conducted last summer by the City of Saskatoon, Saskatchewan, Canada. Before the work was started, laboratory testing of the 1500-foot, medium to heavily travelled roadway was done to determine: 1) Natural water content; 2) grain size; 3) liquid and plastic limits; 4) com-

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STREET AND AREA LIGHTING STANDARDS IN STEEL AND ALUMINUM

paction on natural material and on material with various percents of cement added: and 5) compression strength tests on sample mold made from materials listed in part 4. When test values were established and a compressive strength of 300 psi was established as the minimum required, construction operations began with the shaping of the roadway by a patrol grader. Scarification and pulverization were followed by distribution of bagged cement, spotted in a grid pattern. Sacks were then broken and the surface again pulverized with water added. Compaction followed and

the compacted surface was sealed with 0.25 gal. per sq. yd. of MCO. The street was closed for a seven day curing period and a sand-seal coat of 0.25 gal. of RS 2 and 25 lbs. of sand per square yard was applied. Cost of the experimental work was \$1.30 per square yard, which officials believe could be reduced to \$1.05 per square yard through use of bulk cement and a cement spreader.

"Soil Cement for City Streets?"
By E. J. Cole, City Engineer, Saskatoon, Sask. Roads and Engineering Construction (Toronto, Canada). January, 1961.

Bridge Waterproofing

By late 1961, the New York Thruway Authority will have waterproofed and restored deck surfaces on 309 structures. The program, being done by specialized maintenance forces, is expected to cost \$3 million. The bridge problem, one being experienced on many high-speed, high - volume highways, includes early cracking and break-up of wearing surfaces; leaking construction and expansion joints; deterioration of curbs, sidewalks and substructure: and some disintegration of structural slabs. Early attempts to seal the structures with silicones were not successful. A concerted program of joint sealing, with twocomponent, cold-applied material being the most suitable, followed but proved insufficient by itself. The current program provides for a comprehensive treatment including: 1) Removing cracked & broken concrete; 2) sealing all joints; 3) sealing all uncovered areas of the structural slab; 4) drilling weep holes at low points; 5) replacing wearing surface with asphaltic concrete base course material; 6) sealing all portions of the bridge pavement and patches with a tar emulsionsand slurry; 7) placing a 11/2 inch asphaltic concrete top course on the entire bridge pavement; 8) applying another tar emulsion slurry seal onto which is sprinkled a silica-sand

"New Waterproofing Methods for Thruway Bridges." By W. J. La-Fleur, Assistant Superintendent of Maintenance, New York State Thruway Authority, Albany, New York. Roads and Streets, February, 1961.

Motorist Services on Interstate

Ohio, with over 300 miles of Interstate highways now open, has appointed a full-time coordinator of motorists services to assemble and distribute information on services available to Interstate motorists on adjacent highways. The Interstate travelers problem is two fold: 1) No vehicular service facilities on the roadway and 2) the need for adequate driver rest areas. To aid the motorist and supplement the activities of the State Highway Patrol, maintenance employees are instructed to render whatever service they can while performing maintenance duties. A courtesy patrol was operated on a 37 mile section during September to evaluate service needs and costs. Based on this

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trial operation it was estimated that such a patrol would cost about \$966 per year. Types of services required by the 576 stops made during the 30-day trial period were: Driver sleeping or resting-247; mechanical trouble-131; flat tires-93; driver left vehicle on berm-38; water-32; out of gas-21; and other-14. About one motorist in every 324 traveling the roadway required service. Ohio has initiated positive steps in providing rest areas with drinking water, toilet facilities and picnic tables. These areas are or will be lighted, have telephone facilities and provide a "motorist information center" in which display maps and information on services available adjacent to the Interstate highway are mounted.

'Serving Interstate System Motorists and Their Vehicles in Ohio.' By James V. Musiok, Engineer of Traffic, Ohio Department of Highways. A paper presented at the 40th Annual Meeting of the Highway Research Board, Washington, D. C.

Other Articles

"Basic Principles of Pavement Design." Part one, of this three part article, presents the fundamental concepts for the design of highway and airport pavements. By E. J. Yoder. Associate Professor, Purdue University. Public Works, March, 1961.

"How Much Do You Spend for Mowing?" A balance of chemical and mechanical operations promises the most effective and economical turf management program. By W. L. Hottenstein, Assistant to the Chief Engi-Turnpike Commission, neer. Ohio Berea, Ohio, Public Works, March,

"Repair Zone Signing and Protection." Work areas on high speed highways need carefully engineered warnings. B. H. Bowman, Traffic and Safety Engineer, Ohio Turnpike Commission, Berea, Ohio. Public Works, March, 1961.

"The Toronto Pedestrian Crossover Program." An outline of the development, operation and effectiveness of pedestrian crosswalks in Metropolitan Toronto, Canada. By Morris Rotman, Accident Analysis Engineer, Toronto Department of Public Works. Traffic Engineering, February, 1961.

"Chemical Control Verges." Effects of chemical treatment of roadside areas were studied by evaluation of trial plots at Bibury in Gloucestershire, England. Roads and Road Construction (London, England). January, 1961.

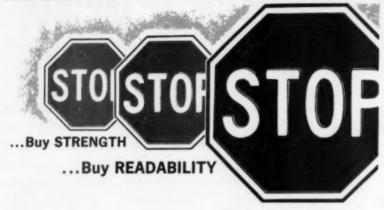
"Evaluation of Rigid Pavement Performance with Special Reference to Airports." The evaluation of rigid pavements and its application for regulation of traffic loads and in strengthening programs. By C. L. N. Iyengar, Associate Member, Senior Engineer. Concrete Association India, Bombay, India. Journal of The Institution Engineers (India), of November, 1960.

"Rapid Transit for Los Angeles." System proposed would provide highspeed, electric-powered transit vehicles running on rubber tires on concrete tracks. By I. F. Mendenhall, President and D. R. Miller, Project Manager, Daniel, Mann, Johnson & Mendenhall, Los Angeles, California. Civil Engineering, February, 1961.

"Epoxy Resin Adhesive Ties Widening Strip to Old Slab." The new bonding material used in Iowa concrete pavement widening program. Roads and Streets, February, 1961.

HEATER-PLANERS GET BIGGER

EATER-PLANING for removal of excess bituminous material to prepare pavements for resurfacing reached new production records recently at two Air Force bases when a newly-built machine was put into operation. The new heaterplaner, latest in a fleet designed and built by Jim Jackson, Contractor,



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Uniformity ... uniformity of strength, readability, and durability is the key to economical signing without compromising quality. Miro-Flex embossed signs are the answer. These tough, weather-resistant signs offer snap-out legibility of raised lettering with baked-enamel finish. Extra strength and rigidity bring a standard of uncompromised quality to the traffic control sign field. Reflectorized signs also available with moisture-proof beads, reflective sheeting, or plastic lenses. Made of zinc-coated, Bonderized steel, Miro-Flex sells the best sign on the market. Stop, buy strength - Stop, buy readability - Stop, buy durability. Competitive makes are . . . rarely as attractive . . . never so enduring.



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Where quality is a habit

Little Rock, Arkansas, first saw duty at Ellsworth AFB in Rapid City, S.D., where quantities of asphalt removal, some to depths of 4 inches, was required. Close checks on production revealed that on three successive days removals exceeded 100 tons of asphalt pavement per hour.

From Ellsworth the machine went directly to Truax AFB at Madison, Wisconsin. Here the job called for removal of a ¼-in. seal coat that was flaking loose, a condition that caused severe tire wear and hazard to jet engines. Although this work was estimated to take 140 hours, the job was completed in 51½ working hours.

These records indicate the progress Jackson has made in his efforts to design a heater-planer which will operate on an equal production basis with normal asphalt placement operations. The latest machine is the result of four years of study by Jackson and his firm, specialists in the planing field. It is the forerunner of some 50 planers scheduled to be built in the next five years.

The new machine incorporates a fascinating variety of attachments and adaptations of standard units. Built around a modified Caterpillar Model 14 motor grader, the planer

weighs over 25 tons, is 43½ feet in length and can operate efficiently at speeds of over 125 feet per minute.

Perhaps the most important improvement is in the heating arrangement. The furnace, which is 8½ feet long and 8 feet wide, is completely lined to reflect a radiant heat on the pavement rather than a direct flame. Six large Hauck burners and a Hauck turbo-blower are used for heating. Three thermocouples in the combustion chamber help maintain a uniform heat over the entire surface, eliminating guesswork and possible pavement damage.

Softened bituminous material is removed by highly tempered steel cutting edges which are mounted vertically behind the furnace in a "V" shape. Since the apex of the "V" is to the rear, stripped material is windrowed in the center of the machine's cut. A patented hydraulic loading device picks up the windrow and deposits it on a Barber-Greene belt conveyor which, in turn, loads the material into a dump truck that is towed along backwards by the planer.

Electricity to operate these attachments is supplied by a 15 KW Winpower generator mounted on the side of the machine. Power comes from the main engine through a Dumor power take-off. The engine rpm is constantly changing whereas the generator requires a reasonably constant-speed input. Therefore, Jackson installed two variable pitch pulleys—in reverse of their normal application. They are activated by an electric motor which in turn is controlled by a Synchro-Start speed sensitive switch. Thus the generator rpm is maintained within a pre-set range.

Two additional features are to be incorporated into Jackson's new planer. The first is a vacuum cleaner to pick up fine dust that sometimes remains after planing particularly dry pavements, the other is a spray bar on a fine film of asphalt in cases where the resurface coat will be delayed or where no cover coat is intended. Both of these attachments will eliminate another separate operation and result in further cost reductions.

Because of the greatly increased production of the new heater-planers, with consequent decrease in square-yard costs, this operation is being specified more frequently than ever by state, county and city agencies responsible for resurfacing of asphalt pavements.



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● TRAFFIC striper by Wald is shown here at work marking of METAL STOP sign is being installed after it has been out parking stalls. It is also used for centerline striping.

Traffic Sign and Marking Maintenance in a Small City

FRANK FORCE Manager-Engineer, Borough of Hellertown, Pa.

WITH the purchase of a 3M sign applicator, the Borough of Hellertown, Pa. will reflectorize all of their traffic control signs with

The Economist, a 26 in. x 30 in. table model vacuum applicator, is operated by one man and is being used to reflectorize all regulatory, warning, guide and special information signs. The applicator weighs approximately 95 lbs. and is operated by a vacuum pump and motor. The unit operates on a 220 volt, single phase, 60 cycle power supply. The total cost of the Economist was

To buy new stop signs with reflective sheeting would cost approximately \$10 per sign. By applying the sheeting to the present signs the cost should be approximately \$4 per sign, including labor and material.

Signs in place in the Borough at the present time include: 110 stop signs, 173 regulatory signs and 15 warning signs. To face these 298 signs with Scotchlite will cost approximately \$750.

The Borough uses Minnesota Mining Centerlite for center line striping on all streets. Tropical paint, yellow and white, was bought for parking stalls and curb painting. A Wald traffic striper is used to apply the paint.

Approximately 1200 lin. ft. of Nefslabs plastic traffic markings purchased from the J. W. Neff Laboratories, Inc., Stockertown, Penna. have been applied to the pavements for traffic control. These

 BOROUGH employee uses a vacuum applicator to put reflectorized face on one of 298 traffic control signs.

strips, arrows and letters should last five to seven years. Having completed a third winter of wear, the plastic has withstood snow plowing. tire chains and temperature changes.

Another safety product used by the Borough is Codit, made by the Minnesota Mining Co. Codit is a reflective coating designed for direct application to clean, dry surfaces which can be painted on concrete, metals, wood products and trees. Application is similar to that for most paints and a single uniform coat should be applied. The Borough employees used a stiff bristle brush to apply Codit but it also can be sprayed on or a hand roller can be used. The application rate is approximately 35 sq. ft, per pound for a single coat. Used on trees, poles and hydrants at dangerous curves, the accident rates have fallen considerably at these points.

The Street Department performs all traffic striping, sign installations and maintenance. Superintendent of Streets is Clarence Trauger and Chairman of the Street Committee is Harry Gregory. William Ward of Minnesota Mining and Mfg. Co. was very helpful in teaching Borough employees to operate the sign applicator.

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The Safety Spreader can be pulled by any vehicle equipped with power takeoff. (Optional auxiliary engine available at extra cost eliminates need for PTO). Distributes sand, salt, cinders and other types of removal material. Spreads accurately at all speeds; spreading patterns adjustable from 3 to 32 feet.



Write for Bulletin A-453.

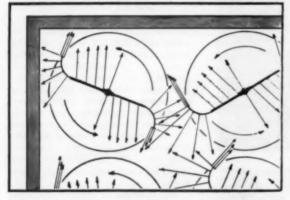
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for Bulletin #38

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Nuclear Energized Self-Luminous Signs for **Highways**

This article is based on a rep pared by J. Clarke Williams, Chief, Nu-clear Energy Branch Division of De-velopment, Office of Operations, Bureau of Public Roads, U. S. Department of Commerce, Washington 25, D. C.

THE USE of self-luminous signs employing isotope - activated phosphors has become commonplace in industrial plants during the past few years and is presently finding increasing use in aircraft, on instrument panels and in the cabins. Application of the same principle, with development to increase the magnitude of visibility from a few feet to a range between 1,500 and 2,000 ft., is entirely feasible. Adequate radiation shielding, to comply with Atomic Energy Commission regulations for protection to personnel having occasion to be around the sign, and to the public, is no problem.

Maintenance of the self-luminous sign would be less costly than a comparable electrically lighted sign. Operation of the self-luminous sign would be significantly lower in cost, as electrical power is not required. A transformer, wiring, switches, bulbs and the attention necessary to the satisfactory operation of an electrically lighted sign would be eliminated by using a self-luminous sign. The isotope-activated selfluminous sign has definite advantages over either electrically lighted or reflectorized directional and informational highway signs, where overhead installation is required. The advantages in favor of the selfluminous sign are even more evident when the sign must be placed in a location remote from power lines.

The exercise of present day techniques makes it possible to use the radiant energy available in the isotopes of Hydrogen, Krypton, Radium or other elements to cause certain phosphors to luminesce sufficiently to be seen from a very considerable distance. Self-luminosity may be accomplished satisfactorily, either with a special paint which can be used in the same manner as ordinary paint, or by incorporating the luminescence in plastic letters affixed to the customary sign material.

Maintenance

If luminescent paint is used, the attention required and cost of maintaining the isotope-activated self-luminous sign should be neither more nor less than the maintenance of any highway sign using the usal flat coat paint. Use of plastic letters, containing an embedded isotope-activated phosphor, should entail less maintenance attention and cost than required for a painted sign, as the life of the plastic letter is very long. The isotope chosen would be one with a long half-life (long effective energizing lifetime).

Either the paint or plastic letter type of nuclear-energized self-luminous sign would show to greatest advantage in maintenance attention and cost when compared with an electrically lighted sign. There are no operating costs for the nuclear sign. The cost of an isotope-activated self-luminous paint would be higher than for a good grade flat coat sign paint; however, the difference should be no greater than a few cents per letter. Compared to a suitable reflectorized paint, the self-luminous paint would probably cost no more, and application expense should be lower.

Original cost of the nuclear sign, even one using plastic letters, would be no more and would probably be less than for a comparable electrically lighted sign, which must have all the paraphernalia necessary to mount globes and bring the power to them. In the event the power was brought from a line outside the right-of-way, the cost advantage in favor of the nuclear sign would increase with the distance to the electrical power source.

The radioisotopes used as a source of energy in the nuclear sign are commercially available, and are steadily decreasing in cost per curie as more and more uses are found for them.

Application

Our highway traffic requires the kind of sign which is clearly visible day or night, and is not dependent upon an accessory power source that may fail, or depend on the lights of the vehicle to make it readily readable from where the driver can first see it until it is obscured by driving beyond or under it. The isotope-energized self-luminous sign meets these requirements.

A self-luminous sign is particularly suitable for an overhead installation. This placement has application both in rural areas and in cities, and is especially suited for use on complex traffic interchange structures, allowing the driver to keep his eyes in the direction of travel and pick up necessary driving information and instructions without turning his head to either side.

No research is necessary and but relatively little development remains to be done before the nuclear-energized self-luminous sign can be made available for use. Its use should supplement the other safety provisions being built into our new highways. The development work remaining to be accomplished is primarily that of increasing the magnitude of the luminescence presently used in smaller nuclearenergized self-luminous signs to the extent necessary to meet highway requirements.

Concurrent with production of the new type sign, the highway profession, and industry in general, would benefit by the knowledge gained during the process, always with the possibility of a breakthrough in some other direction. The development work would also produce concrete ideas as to what might be expected in this field in the future.

PREFABRICATED PNEUMATIC SEWAGE EJECTOR STATIONS

Komline-Sanderson's prefabricated ejector stations offer options and construction features not usually available in stations of this type. "" thick station walls, protected by epoxy base paint... cost iron or welded steel receiving pots... valve and fitting accessibility... electronic or mechanical control. Options such as operation counters to meter flaw high water alarm... connections for auxiliary portable air compressors or generators.

K-S stations are designed and built for dependability. Should service be necessary, the K-S service organization is always available.

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Write For Bulletin No. KSM-3

NEW MINIATURIZED WILKINSON LINE LOCATOR

Radically new, powerful, transistorized locating instrument weighs only 4 lbs. and is 1/4 as large as old type pipe locators.

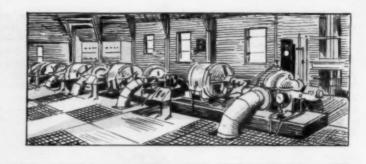
Telescoping aluminum handle; 2 oz. single ear set; all in carrying case.

Write today for brochure and instruction manual.



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Prepared by ALVIN R. JACOBSON, Ph. D.

Associate Professor and Head, Division of Sanitary Science, Columbia University School of Public Health

Adjustable-Speed

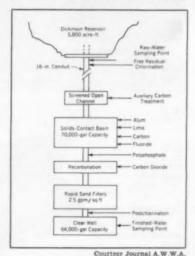
Adjustable-speed centrifugal pumps are well suited for systems for which pipe friction is a predominant factor to be considered. In the selection of pumping equipment proper attention must be given to first cost, annual operating cost, mechanical layout of equipment and piping, availability of power and control problems. Selection of pump drives depends on control, characteristics of the available power supply and economic factors. The number of pumps to be used in a given station is generally established by the hydraulic considerations alone. Fewer adjustablespeed pumps than constant-speed pumps are required for a given job. The savings that result from the use of fewer units more than offset the initial higher cost of variable-speed drives. In addition, because of the improved operating efficiency of a modern adjustable-speed unit, substantial savings in power costs are possible.

"Adjustable-Speed Pumps for Utilities." By Adam W. Kubik, Cons. Engr., O'Brien & Gere, Syracuse, N.Y., and Kenneth H. Mc-Ewan, Div. Salesman, D-C Specialty Drive Sec., Westinghouse Electric Corp., Buffalo, N. Y. Journal AWWA., February, 1961.

Fish Poisons in Water Supplies

In two previous articles the authors have presented the results of investigations taken to determine the feasibility of treating water that had been contaminated with a fish poison. These investigations showed that both toxicity and odor produced by the presence of fish poison formulations in raw water supplies can be reduced to safe and palata-

ble levels by treatment with activated carbon in a water treatment plant. On the basis of the results of these studies, the North Dakota State Game & Fish Department carried out a fish killing operation on the Dickinson Reservoir and tributary influent streams with an average of 2.0 mg/L of a commercial (2.5 percent rotenone) fish poison formulation. Treatment at the water plant consisted of adding 61 mg/L activa ed carbon, which effectively reduced the toxic and odorous components to safe and palatable levels. The components toxic to fish decomposed at a rapid and uniform rate and could not be detected in the raw water at the end of 3 days. The odor component of the fish poison dissipated more slowly, but it also could not be detected at the end of 6 days. During this time, decreasing dosages of carbon were required for proper treatment of the



FLOW diagram of the Dickinson, N. D., water treatment plant, where special measures were taken to eliminate fish poisons from the raw water.

water. Consumer acceptance of the water was good.

"Effect of Fish Poisons on Water Supplies." Part 3. Field Study at Dickinson. By M. Cohen, Chemist; Quentin H. Pickering, Biologist; and Richard L. Woodward, Chief, Eng. Sec., all of Water Supply & Water Pollution Research Branch, Robert A. Taft San. Eng. Center, Cincinnati, Ohio; and Willis Van Heuvelen, Director of Public Health, State Dept. of Health, Bismarck, N. Dak. Journal AWWA., February, 1961.

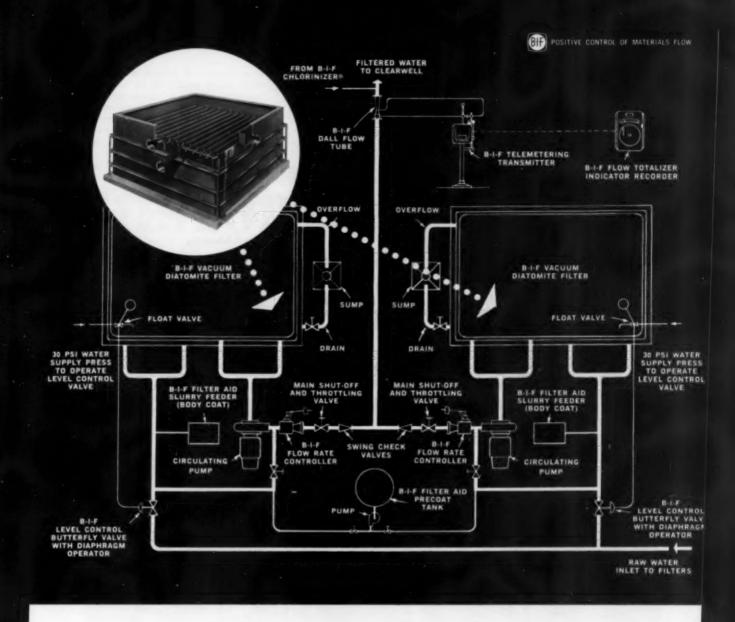
Economical Small Town Water Systems

The problems of design, construction and financing of small town water systems are as important and challenging as those facing the large cities. The author cites six examples, with populations ranging from 500 to 10,000 persons, clearly indicating their problems, and the best approach to their effective engineering solutions. These case histories point out the importance of engineering and feasibility studies to guide construction planning. Any community can have an adequate water supply and distribution system if it will face up to realistic tax valuations and assessments and if it will recognize realistic water rates objectively.

"Small Town Water Systems Can Be Built Economically." By L. A. Schmidt, Jr., President, Schmidt Engineering Company, Inc., Consulting Engineers. Water Works Engineering, February, 1961.

Automation in USA Water Works

The water works industry in the USA is developing and installing systems which will ultimately be-



New **B-I-F** low cost filtration system meets peak load demands!

You no longer need high cost expansion to meet peak load demands. At a fraction of the cost formerly required, B-I-F can provide a completely integrated filtration and treatment system. The low installation, operational and maintenance costs save thousands of taxpayers' dollars.

This B-I-F system is built around low cost, performance proven Vacuum Diatomite Filters. The filters' open tank design permits simple visual operation . . . and easier inspection and accessibility. Fiberglass construction eliminates annual painting and repair of protective linings. Chemical pre-treatment is simplified. Wash water requirements are minimized.

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come fully automated. The controls of the purification process are being centralized so that one employee can control the operation of a large plant by first having the field data telemetered to his headquarters and then providing push-button, remote-control for his use. The same is true of pumping stations particularly where there are many related stations. The modern concept of controlling a water works during maximum and minimum loads, seasonal load changes and emergency conditions, first requires an intelligence center. This provides instantaneous knowledge of the system

operation and permits control of trunk main valves to provide good pressures in the system, as well as good quality of water. In the larger water works, more and more key valves are being placed under automatic or remote supervisory control providing faster action and, therefore, better service. In conclusion, the author points out that we, in the USA, are rapidly reaching the ultimate in automatic operations in specific areas of water operations. The assembling and integrating of all functional data is the step that the water industry is now going through. The final step

of a completed automated water works plant would be to add the "thinking electronic computer" as the necessary link to provide complete feedback automation, thereby providing better service, better quality, and optimum economic operations.

"Automation in USA Water Works." By V. A. Appleyard, Chief of Water Operations, Water Department, Philadelphia, Pa. Water & Sewage Works, February, 1961.

Iron Chemistry Studies

Iron is one of the most common and widely distributed elements in the earth's crust and its chemical behavior generally favors its retention in minerals of low solubility. Dissolved iron is usually present in minute concentrations in natural waters except when special chemical conditions exist. The solubility of iron is controlled by the redox potential, pH, and concentration of carbonate and sulfur anionic species. These factors can be summarized by means of stability field diagrams as the author has done in this article, the diagrams being graphs having Eh as the ordinate and pH as the abscissa. In the absence of chemical complexing and excessive amounts of carbonate, the pH and iron content of a ground water may serve as an index of the redox potential of the water in its natural environment. Areas of stability shown on the graphs for the different ionic or solid species of iron are located by computations with the use of standard free-energy values selected from published literature. The stability field diagrams summarize the conditions required for stability of solutions containing 0.01-100 ppm iron, and indicate some factors that control solution and precipitation of iron in natural water.

"Stability Field Diagrams as Aids in Iron Chemistry Studies." By John D. Hem, Research Chemist, Water Resources Div., USGS, Denver, Colorado. Journal AWWA., February, 1961.

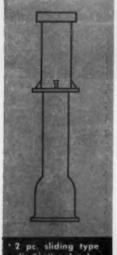
New 30-MGD Potomac River Plant

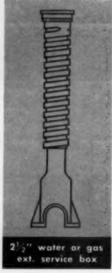
The first phase of the new \$29 million Potomac Water Supply Development Project has been completed and is now serving the suburbs of the Nation's Capital. So rapid is the population growth (present population, 600,000) in the Washington Suburban Sanitary



are available in every size and style!

No matter what size, shape or style municipal casting you may desire — you're practically sure to find a "Buffalo" casting to serve your needs. Or, where desired, castings may be made to your own specifications. Whether you need valve, service or roadway boxes, meter boxes, manhole rings and covers or other municipal castings, you'll find all "Buffalo" castings designed for service and dependability.







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CASE HISTORY

Total Deming Turbines 3
Total Service Years 32
Total Service Calls



| MAINTENANCE | RECORD- |
|-------------|---------|
| DEMING P | UMPS |

| Year | Pump #1 | Pump ≠2 | Pump #3 |
|------|---------|----------|---------|
| 1949 | none | none | |
| 1950 | none | none | NEW |
| 1951 | none | none | 1953 |
| 1952 | none | none | |
| 1953 | none | none | none |
| 1954 | none | none | none |
| 1955 | none | none | none |
| 1956 | none | none | none |
| 1957 | none | none | none |
| 1958 | none | serviced | none |
| 1959 | none | none | none |
| 1960 | none | none | none |
| 1961 | none | none | none |

Engineered for emergencies and normal, variable demands, three DEMING Turbine Pumps keep pumping costs at a minimum in the modern water works at Richmond, Missouri. Each pump has a capacity of 500 G.P.M. against a 400-ft. head. As the well water has a certain iron content, it is aerated, chemically treated and pumped into a reservoir.

In the event of power failure, the pump direct-connected to the diesel engine takes over to meet emergency demands.

Low Maintenance Costs

Three DEMING Turbines, each with 60 h.p., 1750 r.p.m. vertical motors, meet minimum to maximum load

demands at Richmond. Two of these were installed in 1949. Since that time, one of these pumps received a routine overhaul in 1958, otherwise neither pump has needed maintenance. The other DEMING Turbine, installed in 1953, has required no service of any kind.

The many features of DEMING Vertical Turbine Pumps offer practical advantages in water works service. For complete information on the complete line of DEMING pumps for municipal service, write to:

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Commission's 427-square-mile service area, that the WSSC has recently scheduled the preparation of design-construction plans for the second phase of the plant in its Five-Year Water Program, thereby doubling the production capacity from 30 mgd to 60 mgd to meet the anticipated growth of the District area population. Four more 30-mgd segments are planned about 10 years apart through 1990. The plant itself is of conventional design, consisting of two flocculation basins with paddle-wheel flocculation; four 80-footsquare settling basins equipped with Walker Process sludge skimmers:

and six filters of 5-mgd capacity each. A single 6.5 mgd filtered water storage reservoir is part of the plant's first-phase construction, but space has been reserved for 3 additional reservoirs of similar capacity. Prechlorination and post-chlorination are provided. The existing system includes 1,650 miles of water mains, 16 pumping stations and 31 storage tanks which have a total storage capacity of 81 million gallons.

"New 30-Mgd Potomac River Filter Plant in Service." By Robert J. McLeod, Chief Engineer, Washington Suburban Sanitary Commission. Water Works Engineering, February, 1961.

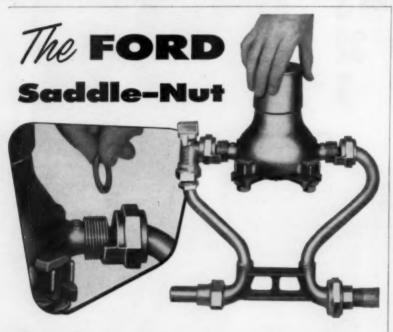
Membrane Filter Technique

The City of San Antonio, Texas, obtains its water from wells and is virtually of coliform-free quality. Any work on the distribution system which could introduce contamination is given considerable attention. Such work includes the laving of new mains, repairing breaks and miscellaneous activities. All newly constructed mains are withheld from service until they have been demonstrated to be free from contamination. The Membrane Filter Technique has been used on main disinfection samples because of the considerable reduction in time when results are available. In this paper the author summarizes the results of work showing the good correlation obtained between the Membrane Filter and Fermentation Tube methods on a total of 2,451 samples analyzed during a 22month period. Dual analyses were performed on this total of samples obtained from 312 water main construction projects involving cast iron, steel, cement-asbestos and reinforced concrete pipe. Among the advantages of the Membrane Filter Technique over the Fermentation Tube Method is the speed with which results are available, 18 hours instead of 5 days, as required by the latter method. This means that a main may be checked after a period of chlorination, and placed back into operation or rechlorinated on the day following initial sampling. Also, the main may be released 18 hours after sampling resulting in earlier meter installation and faster service to customers, developers or builders. The Membrane Filter Technique has also been used on samples taken during occasional emergencies, including outbreaks of illness, flooding and checking for suspected contamina-

"Membrane Filter Technique."
By I. J. Benedict, Sanitation Supervisor, City Water Board, San Antonio, Texas. Water & Sewage Works, February, 1961.

Natural Filtration

Carmichael, California, is a booming residential community lying to the East of Sacramento, which was an agricultural area prior to World War II. But in the 10-year period following the War, the population



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Save time Save trouble Save gaskets, by putting the FORD SADDLE NUT at inlet, or both ends of every meter installation.

The patented Ford Saddle Nut has a supporting lip extending about half way around the meter nut, so that it supports the weight of the meter, lines up the threads of the nut with the meter spud, and provides a place to hold the gasket before the nut is screwed onto the meter.

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stock only ONE split sleeve...

for almost all break and leak situations







Style 126 completely encloses broken or leaking joints ... tightens up permanently in a matter of minutes ... without taking line out of service. Fully described and illustrated in Bulletin 1052. SEE YOUR MEARBY BRESSER DISTRIBUTOR FOR THE FULL STORY.

Dresser Style 126 BELL-PACK® Repair Sleeves take on a variety of breaks and leaks in cast iron pipe. Stock only ONE for each pipe size. They make split bells and broken mechanical joints leakproof in a matter of minutes. These easy-to-put-in sleeves will pay for themselves when you can't take a line out of service—one of those breaks in the middle of Main Street, 4:00 AM on a windy, sleeting morning! No more makeshift repairs, shutdowns and involved operations with cumbersome gear. Style 126 repairs are fast, economical and permanent. They pack tight on deflected or offset pipe...

and there's no cutting or trimming of gaskets. There's a complete size range—3" through 24". Standard sizes fit AWWA CIP through class D; AGA; Super DeLavaud; Standardized Mechanical Joints; mechanical couplings; flanged joints and Universal joints through 8".



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> OIL = GAS CHEMICAL ELECTRONIC INDUSTRIAL

of the area trebled, while within the past five years the population has again doubled bringing it to an estimated 20,000. Among the many problems created by these changes, the most important was that of water supply. The water supply of the area is furnished by the Carmichael Irrigation District, organized in 1916. It originally obtained water for irrigation and domestic use by pumping untreated water from the river and delivering it to the users through redwood stave pipes. By 1957, the water system had been expanded until it consisted of two river pumping stations, three vertical deep

wells, and approximately 57 miles of water mains. The surface water. the major source of supply, was still being pumped directly from the river, the treatment consisting only of intake screening and chlorination. The water delivered to the consumers was of unsatisfactory quality because of turbidity, taste and odors, or bacterial contamination. In the summer of 1957, an engineering study was authorized to determine the most feasible plan for developing an adequate supply of satisfactory quality. The major feature of the selected plan consisted of developing an infiltrated

water supply from the American River by the construction of four Ranney collectors. Each collector consists of a vertical circular shaft (or caisson) 13 feet in diameter with 18-inch reinforced concrete walls. The caissons were sunk, by open excavation methods, into the underlying sands and gravels to variable depths below ground surface, ranging from 21 feet to 46 feet. A concrete plug (or seal) was installed in the bottom of each caisson. At depths of approximately 20 feet below river level, five to seven horizontal screen pipes or laterals were extended from each caisson in a semicircular pattern, these varying in length from 23 to 90 feet. On the top of each caisson was constructed an attractive concrete block building which houses deep well turbine pumps and electrical equipment. The pumps are designed to operate automatically thereby minimizing maintenance and servicing. The water produced is clear and odorless and the only treatment is chlorine as a bactericidal agent and lime for the prevention of corrosion.

"Natural Filtration." By John Mc-Allister, General Mgr., Carmichael County (Calif.) Irrigation District. Public Works, March, 1961.

Other Articles

"Progress Toward Water Quality in 1960." Plant improvements completed or initiated in 1960 which will bring higher quality water to the ultimate consumer. By John W. Cramer, Vice President, American Water Works Assn., Inc., New York, N. Y. Water & Sewage Works, February, 1961.

"How to Select and Apply Magnetic Flow Meters." Review of basic theory of magnetic meters and general hints on their proper selection and application. By Leo Carroll, Product Application Engineer, Fischer & Porter Co., Warminster, Pa. Water & Sewage Works, February, 1961.

"Administrative Policies for Utility Extensions." Should be non-discriminatory and based upon business principles assuring that the extension will be self-supporting. By John B. Powers. Engineering Representative, W. S. Dickey Clay Mfg. Co. Public Works, March, 1961.

"Cleaning Methods for Deep Wells and Pumps." Reconditioning of the well and pump can help in recovering lost production. By Claud R. Erickson, Mech. Engr., Board of Water & Light, Lansing, Mich. Journal AWWA. February, 1961.

"Natural Radioactivity in Ground Water Supplies in Maine and New Hampshire." By Benjamin M. Smith,

control



for algae and aquatic weeds

In small amounts, Triangle Brand Copper Sulfate controls algae growth and kills some of the more troublesome aquatic weeds. They disintegrate where they are, which prevents downstream infestation or clogged waterways.

In sewage pipes, Triangle Brand Copper Sulfate can be used in such low concentrations to control root and fungus growth that surface trees remain unaffected.

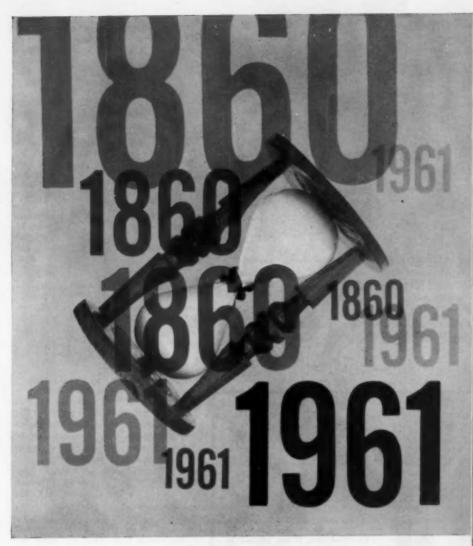
Two informational booklets, "The Use of Copper Sulfate in the Control of Microscopic Organisms," and "Copper Sulfate for Root and Fungus Control in Sanitary Sewers and Storm Drains," available on request.

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Age has its advantages when you are dealing with fire hydrants, because hydrants must provide many years of reliable service. When a manufacturer has been in business 100 years or more, the quality of his product is well known.

R. D. Wood Hydrants have stood the test of time. There are more than a million

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When you deal with R. D. Wood (over 100 years in the hydrant business) you have the comfortable feeling that we will still be around when your equipment needs service or even replacement.

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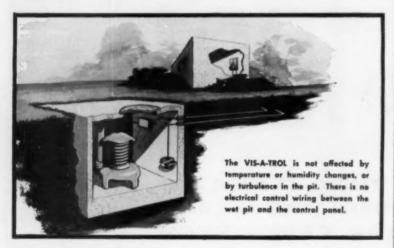
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Submersible sewage and sump pumps
 Vertical type sewage and sump pumps
 Septic Tank effluent pumps

The weil VIS-A-TROL automatic control system is combined with a depth measuring device which shows the depth of liquid in the pit. The pumping rate can be compared with the in-flow at all times without looking into the wet pit. It is indicated on the instrument and responds instantly to level changes in the sump.



The VIS-A-TROL can be installed in outside weather-proof enclosures or installed within a building and may be located as much as 300 feet away from the pumping pit. High and low limits of liquid level control are set at the instrument. It is never necessary to go into the wet pit for control adjustment.



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Graduate Research Asst., Werner N. Grune, Prof. of Civ. Eng.; and Frederick B. Higgins, Jr., Graduate Research Asst., all of San. Eng. Research Laboratories, Georgia Institute of Technology, Atlanta, Ga., and James G. Terrill, Jr., Asst. Chief, Div. of Radiological Health, USPHS, Washington, D. C. Journal AWWA., January, 1931.

"Nature and Control of Radioactive Wastes in Pennsylvania Waters." By Walter A. Lyon, Director, Div. of San. Eng., Pennsylvania Dept. of Health, Harrisburg, Pa. Journal AWWA., January, 1961.

"Film - Speaker Public Relations Program at Los Angeles." By John W. Baleria, Public Relations Representative, Dept. of Water & Power, Los Angeles, Calif. Journal AWWA., January, 1961.

"Need for a Comprehensive Survey of Water Resources." A discussion of the considerations involved in the use of steam-guaging methods. The Surveyor and Municipal and County Engineer, 29 October, 1960.

New Smog Warning Service

Advance warning of impending severe smog conditions is now available to all cities east of the Rocky Mountains under a new cooperative network operated by the Weather Bureau and the Public Health Service. Bulletins will be transmitted by teletype from the Weather Bureau Research Station, located at the Sanitary Engineering Center in Cincinnati. The station is financed by a Public Health Service grant. "Stagnation Bulletins," so called because the danger of smog is greatest when air is abnormally calm, will be issued whenever weather conditions warrant. With this advance warning, cities can curb traffic, industrial, and other sources of pollution during the danger period. The Stagnation Bulletins will be distributed through local Weather Bureau stations and, normally, only to air pollution control officials and representatives of industry, to inform them of weather conditions likely to contribute to the buildup of high levels of air pollution. Interested agencies or groups may make arrangements to receive the forecasts by getting in touch with the Meteorologist-in-Charge at the nearest U.S. Weather Bureau station. The new, year-around, forecasting program has been developed from similar programs carried on from a more limited scale during the fall seasons of the past three years.



A complete Celite diatomite filtration system can eliminate the costs of conventional pre-treatment facilities

Now you can do something about skyrocketing per capita water consumption costs—as are dozens of municipalities every year. And get clearer, sparkling-bright water in the bargain!

Install one of today's small compact diatomite filtration plants, using Celite* filter aids. In many cases, raw water can be filtered directly, eliminating several of the costly conventional pretreatment stages—flocculation, quick-mixing tanks, and settling tanks, for example.

Result[†]: Filtration plants requiring only ½ the space of sand plants of equal capacity. Capital costs cut almost in half—savings of up to 45%.

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Mined by Johns-Manville from the world's purest commercially available diatomite deposit, Celite is carefully processed for uniformity. You have a wide choice of grades for best balance of clarity and flow rate. For further information, call your nearby J-M Celite engineer. Write direct for free technical reprints and illustrated brochure. Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

- Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.
- † See Computison Studies of Diatomite and Sand Filtration by G. R. Beil, Journal American Water Works Association, September, 1956, or write for free reprint.

JOHNS-MANVILLE





FILMS in Brief

Listed below are motion picture films of current interest to engineers, administrators and supervisors in the public works field. The companies providing these films have indicated that the films are available for appropriate use by PUBLIC WORKS readers. Requests for films should be made direct to the company listed with the film.

"Good Riddance." Documents the progress and problems of an eight-state crusade for clean streams. (30 min., color.) Ohio River Valley Water Sanitation Commission, 414 Walnut St., Cincinnati 2, Ohio.

"The Hveem Method for Design of Hot-Mix Asphalt Pavements." This technical training film describes and illustrates the procedures involved in the testing of asphalt paving mixes. (2 min., color, sound, 16 mm.) The Asphalt Institute, University of Maryland, College Park, Md.

"Incineration." Designed to encourage the use of incineration and to show the principles and representative methods of refuse disposal. (13 min., color, sound, 16 mm.) Communicable Disease Center, Atlanta 22, Georgia.

"Shortening the Cycle." The story of the seven yard model S-7 scraper specifically designed for small jobs and useful for county and city public works and maintenance programs. Euclid Division of General Motors Corporation, Cleveland 17, Ohio.

"Concrete in the '60's: Report No. 1." A continuation of a news reel series issued annually showing highlights of outstanding construction projects, news events and new applications of concrete. (23½ min., color, sound, 16 mm.) Local district office of the Portland Cement Association.

"Better Roads Ahead." Portrays the use of Vinsol Resin in concrete as an air-entraining agent. (10 min., color, sound, 16 mm.) Advertising Department, Hercules Powder Company, Wilmington 99, Delaware.

"A Decent Burial." How useless land can be transformed into taxable property through the sanitary landfill method of garbage disposal. (12½ min.) Caterpillar Tractor Co., Peoria, Ill.

"The Long Street." The effects of super highways upon daily living as seen through the eyes of a small-town druggist who fears the consequences of a new super highway under construction. (30 min., color, sound, 16 mm.) Advertising Division, Ingersoll - Rand Company, Phillipsburg, New Jersey.

"Pozzolith." Shows how Pozzolith and its adaptations are employed to improve the control of concrete quality. (Color.) The Master Builders Company, Cleveland 3, Ohio.

"Clear Roads Ahead." Illustrates the use of straight rock salt to obtain open safe streets and highways in winter weather. (8 min., color, sound, 35 mm.) International Salt Co., Clarks Summit, Pa.

"All-Weather Tracks." Describes recent developments in surfacing materials for all-weather running tracks including step-by-step construction procedures. (19 min., color, sound.) American Bitumuls & Asphalt Company, 320 Market St., San Francisco, California.

"Bridge to the Future." Shows the intermediate phase of work being performed in building the gigantic Glen Canyon Dam in northern Arizona. (30 min., color, sound, 16 mm.) Consumer Relations Department, International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.



Scene from "Bridge to the Future."

Canton Job Moves Fast With Easy-To-Lay Concrete Pressure Pipe

In large photo at right, backhoe has dug trench and is lowering pipe into position.



Here workman lubricates rubber gasket for easyto-make, bottle-tight joint.



Joint is made and crew checks position with alignment square,



Workman pours grout to finish up joint as crew moves ahead with additional sections,

This 17-mile line runs from the new Sugar Creek treatment plant southwest of Canton. The prestressed concrete steel cylinder pipe is mostly 42-inch, with some 36-inch. It is the kind of pipe you "bury and forget," requiring little or no maintenance. The Superintendent of Water at Canton is Alfred E. Ransom. Beiswenger, Hoch & Associates were the consulting engineers. The pipe was manufactured by Price Brothers Company with headquarters plants in Hattiesburg, Mississippi and Dayton, Ohio.









Prepared by ALVIN R. JACOBSON, Ph.D.

Associate Professor and Head, Division of Sanitary Science, Columbia University School of Public Health

Activated Sludge

Much work has been done on the effects of temperature and feed composition on the operating characteristics of activated sludge treatment. This report is an effort to provide additional data on this problem. Continuous activated sludge bench units of 51/2 liters capacity were used for testing. These units were operated at 5 and 30°C. with the same applied load, volume, and concentration. Four different feeds were tested: a) slurried dog food meal; b) dextrose and gelatin; c) dog food meal, dextrose, and gelatin; and d) phenol. All were fed in weak, settled sewage to provide supplementary nutrients. The authors concluded that: 1) Temperature of activated sludge operation had a significant effect on the variety and motility of the predator population; 2) two weeks or more were required for the population to approach characteristic equilibrium and performance after a significant temperature change: 3) acclimation to different test feeds required about five times as long at 5°C as at 30°C: 4) BOD and COD removal was about 10 percent higher at 30°C, than at 5°C, when the influent was treatable at both temperatures; 5) solids accumulation per unit weight of BOD input was substantially greater at 5°C than at 30°C; 6) low temperature flocculation was substantially inferior to that at 30°C: 7) soluble feeds tested were much more sensitive to low operation temperatures and contributed to poorer flocculation; 8) higher nitrogen requirements at 30°C followed anticipated behavior but excess nitrogen at 5°C was detrimental: 9) nitrification was not significant at 5°C; 10) foam difficulties were increased by low temperature operation; 11) sphaerotilus apparently had a better competitive position

at 5°C; 12) sludge volatile percentages usually were about 5 percent higher at 5°C than at 30°C on the same feed.

"Temperature and Feed as Variables in Activated Sludge Performance." By F. J. Ludzak, R. B. Schaffer and M. O. Ettinger, all staff members of the Robert A. Taff Sanitary Engineering Center, U. S. Public Health Service, Cincinnati,

Ohio. Journal WPCF, February, 1961.

Manning's

Ever since Robert Manning proposed his formula in 1889 a number of people have attempted to obtain more precise values for n and the factors that influence the velocity of flow in a conduit. It was with

108-Inch Corrugated Metal Pipe for Bypass



BYPASS will be used during construction at the Los Angeles Hyperion plant.

A N ASPHALT-lined corrugated metal pipe 108 in. in diameter is serving as a sewer bypass during modification of the Los Angeles Hyperion sewage treatment plant. Use of 65 ft. of the pipe is permitting installation of an electrically-controlled gate in an outfall line

with no interruption in service. The 108-inch 8-gage corrugated metal pipe was fabricated and lined by Pacific Corrugated Culvert Co. of Southern California who delivered the bypass in four sections—three elbows and a barrel. Contractor crews installed.



Gas Production

with P.F.T... Pearth

In the heart of one of Pennsylvania's most beautiful resort areas is the thriving community of Stroudsburg. Its sparkling streams and invigorating mountain air have not only made this an attractive residential area but inviting to industry as well.

As in over 200 other communities in the United States, Stroudsburg's sewage treatment plant is enhanced by the benefits of a P.F.T.-Pearth Gas Recirculation System.

P.F.T.-Pearth steps up gas production, eliminates scum and increases digester capacity. Compressed digester gas is injected through properly spaced discharge wells into the zone below the scum layer. Violent agitation disperses the scum and effects intimate mixing of the scum and raw solids with the seed material in the active digestion zone. This steps up digestion of all solids.

There are no moving parts in the digester and no restrictions in the open end gas discharge piping. There is no danger of mechanical failure or clogging with this trouble-free system.

Other P.F.T. equipment at Stroudsburg includes: 1 P.F.T. 30'
Floating Cover, 1 P.F.T. 35' Floating Cover with P.F.T.-Pearth installed in 1954. 1 P.F.T. #250 Heater & Heat Exchanger Unit,
P.F.T. Supernatant Selector and Gauge and P.F.T. Gas Safety Equipment.
Plant designed by Albright & Friel, Consulting Engineers, Philadelphia.



Aerial Photos Shows Stroudsburg Plant with P.F.T. Floating Cover with Pearth in Foreground.



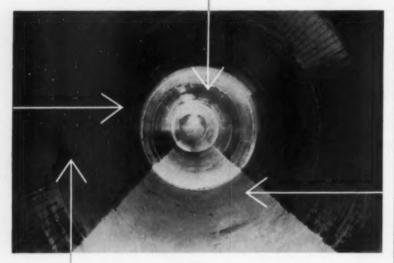
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take a LONG LOOK at sewer linings



It's a Hundred Year Proposition

This 9½-foot outfall sewer extends eight miles, and it will go a long way in years of trouble-free service. The engineers who designed it say that it will still be functioning perfectly well into the 21st Century. One important reason is that every surface above the low flow line is completely covered by a continuous membrane of T-Lock Amer-Plate, the vinyl lining that is impervious to chemical effluents and to the corrosive action of oxidized hydrogen sulfide at any level of concentration.

Engineers know that no one can accurately predict future rates of H_aS gas generation, so they have insured the ultimate life of the concrete by investing an extra 8 to 10% for the absolute protection afforded by T-Lock. They predict that this will spare their city the cost of a replacement sewer in about 20 years, and save the taxpayers millions of dollars!

Where protection is required, only T-Lock is satisfactory because only T-Lock combines complete chemical imperviousness with integral T-ribbed back which mechanically locks into the concrete. Experienced sewer design engineers will not gamble on compromise methods. Millions of square feet of T-Lock are now in use in Los Angeles; Topeka; Wichita; Sioux City; Shreveport; Washington, D.C.; San Diego; Mansfield, Ohio; Huntington, W. Va.; Hutchinson, Kansas; and Orange County, Calif. T-Lock Amer-Plate is also on current specifications for many other municipalities. For complete list of users and specifiers, plus technical data and a typical specification, write:



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921 Pitner Ave. Evanston, III. 360 Carnerie Ave. Kenilworth, N.J. 111 Colgate Buffalo, N.Y. 2404 Dennis St. Jacksonville, Fla. 6530 Supply Row Houston, Tex.

the hope of clarifying the matter of n values that research was undertaken to test pipelines of different materials, slopes, and sizes. In the tests conducted the following kinds and sizes of pipe were used: 4-in. x 4-ft. vitrified clay, 4-in. x 5-ft. centrifugally spun cast iron, 4-in. x 10-ft. cement-asbestos, 8-in. x 5-ft. vitrified clay, and 8-in. x 13-ft. cement-asbestos pipe. The pipes were laid on a trestle about 300 ft. in length and measurements were made at various slopes, rates of flow and sizes of each pipe material. The following conclusions were made: 1) It was found that the n value for a 4-in, line varies with the slope; 2) that the n values for the 4-in. lines tested varied with a change in the rate of flow; 3) the analysis of variance test indicated that there was no significant difference in the n values calculated from the test data collected for 4-in, clay, cement-asbestos, or centrifugally spun cast iron pipe; 4) ranges of n values for the 4-in. cast iron, cement-asbestos, and clay pipe at two slopes tested were determined with a 95 percent confidence: 5) the tests showed that the n values for clay and cast iron are significantly lower on the average, for a slope of 0.004 than they are for a slope of 0.0025; 6) it was found that the true value of Manning's n for each type of 8-in. pipe tested at a slope of 0.004 slope varied from 0.00957 to 0.01105 for clay and from 0.00995 to 0.01079 for cement-asbestos: 7) the analysis of variance test indicated that there was no significant difference in the n values calculated from the 8-in. cement-asbestos and 8-in. clay pipe tests; 8) the tests showed that the rate of flow had an effect on the n values calculated from the data collected during the 8-in. pipe tests; 9) that the n values calculated from the 4-in. and 8-in. pipeline tests were significantly different; 10) the depth-diameter ratio d/D appears to be the principal factor in the variation of n values obtained from the test data.

"Manning's Coefficient Calculated from Test Data." By Don E. Bloodgood, Prof. of Sanitary Engineering and John M. Bell, Graduate Assistant, Purdue University, Lafayette, Ind. Journal WPCF., February, 1961

Phoenix

Treatment Works

For the past two years, the City of Phoenix, Arizona, has operated its sewage treatment plant in what is referred to as a "no man's land"

18 Hydro E-Z Packs pick up 9 million pounds of refuse monthly!

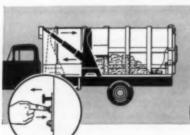


"We've increased pickups more than 50% ... and at a savings of \$50,400 per year."

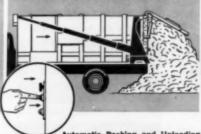
The city of Jackson, Miss., is served by a fleet of 18 Hydro E-Z Packs which pick up more than 9 million pounds of refuse every month. To handle this huge refuse pickup, Walter E. Mixon, Jr., Superintendent of the Jackson Department of Sanitation, chose Hydro E-Z Pack, "Hydro E-Z Packs do a more thorough and complete job than any other type unit we tested," says Mixon, Jackson's E-Z Pack fleet services more than

21,000 homes and 1600 businesses. What's more, the annual operating cost of their refuse removal program has been reduced \$50,400. A savings of \$2800 for each E-Z Pack in operation. Trips to the dump have been reduced too, because of the high compaction rate of 76,600 pounds exerted on the load in every E-Z Pack.

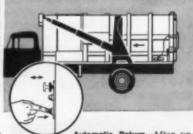
Refuse removal problem? See your Hydro E-Z Pack Distributor or send for free copy of "The Big Squeeze."



Automatic Clearing—With the Push-Pull Switch in the "out" position, the middle button is depressed and the packer blade clears the loading hopper area; then returns to its original position, automatically



Automatic Packing and Unleading
-With the Push-Pull Switch in the "in" position, the middle button is depressed and the packer blade moves to the rear of the body exerting pressure to compact the load. To un-load, the same procedure is followed.



Automatic Return-After un-loading, or during the clearing, packing or unloading cycles, the packer blade can be returned to original position by depressing lower button regardless of setting of Push-



DIVISION OF HERCULES GALION PRODUCTS, INC., GALION, OHIO U.S.A.

Dept. of Sanitation Jackson, Mississippi

process, i.e., somewhere between conventional activated sludge sewage treatment and high rate or modified activated sludge process. The conventional activated sludge treatment process usually removes about 90 to 95 percent of the BOD and suspended solids with about 20 mg/L BOD and suspended solids remaining in the effluent. The highrate or modified treatment, utilizing smaller quantities of air, produces about 75 percent purification with an effluent containing 40 mg/L or more of BOD and suspended solids remaining. At the present time, in the Phoenix plant, 92 per-

cent BOD removal is accomplished with 25 mg/L remaining in the effluent, from a raw BOD of 300 to 350 mg/L. An average of 82 percent suspended solids are removed. These results are being accomplished with 800-830 cubic feet of air per pound of BOD removed. The activated sludge plant was originally constructed in 1932 with a capacity of 12 mgd and expanded in 1947 to serve flows of 30 mgd. The application of the "solids loading" theory in the design enabled the plant capacity to be more than doubled without adding aerator volume, and the operation of the plant in the

years after the completion of construction is a continued story of solids control. At the present time a 15 mgd addition to the plant is under design. This construction will be the first stage of a 60-mgd expansion to be completed within the next few years.

"Phoenix Plant Operates in the Activated Sludge 'No Man's Land'." By Art F. Vondrick. Assistant Water & Sewers Director, Phoenix, Arizona. Wastes Engineering, Feb-

ruary, 1961.

Government Regulations

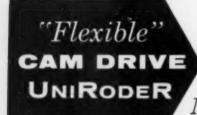
A new regulation was recently adopted by the Central States Sanitary Engineers limiting the permissible loading on trickling filters to 50 pounds of five day BOD per 1.000 cubic feet of filter media to prevent disagreeable odors. The author believes that these restrictions are arbitrary and not based on scientific fact and will increase the cost of construction of trickling filters without compensating benefit. In the first place organic matter gives off foul odors only under conditions of anaerobic decomposition, i.e., in the absence of sufficient oxygen or air. The principal factors resulting in insufficient aeration are usually due to: 1) Poorly designed underdrains that do not permit sufficient aeration; 2) filter media which are undersized and not uniform; and 3) internal local clogging or ponding. The author concludes that, if the filters are constructed of proper media and have adequate underdrains, they will not become anaerobic except at very heavy loadings-much above 50 pounds of 5-day BOD per 1,000 cubic feet of media.

"Government Regulations and the Cost of Sewage Treatment." By Halvor O. Halvorson, Professor of Microbiology, University of Illinois. PUBLIC WORKS, March, 1961.

Gas Scrubbing for H₂S Removal

Soon after the sewage treatment plant at Miami, Florida, was put in operation, the digester gas was found to contain up to 600 grains of HoS per 100 cubic feet. This resulted from infiltration of sea water into the sewer lines. Repair of sewers and increase in solids content to the digesters reduced the H2S by about fifty percent. After a year of experimentation on a laboratory and pilot plant scale, a three-stage injector type scrubber was installed

(Please turn to page 164)



An entirely new principle providing Non-Slip Rod Drive!



Revolutionary! Traveling cams push or pull the continuous rod, rotating with it in either direction. The heavier the load the tighter the cams

grip the rod. NO FRICTION ROLLERS TO SCORE OR BURN. Exclusive Safety Overload Clutch protects pipe, machine and rod. Simplified mechanism and fewer working parts mean less maintenance than any other continuous rodder!

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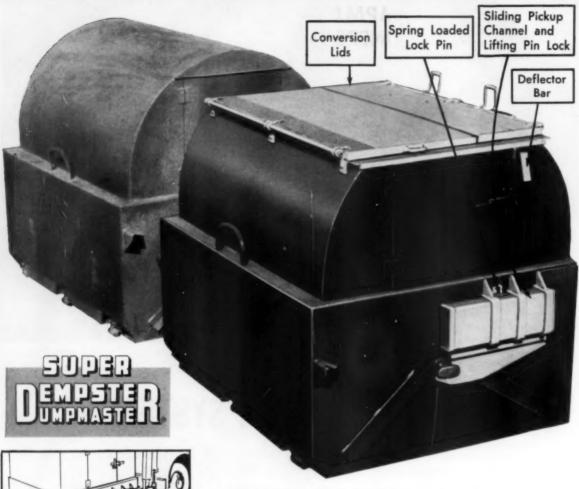
The first truly different approach to activated sludge aeration in the last 30 years

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The D-O INKA system is an exclusive development, based on a new principle of operation. It not only offers higher oxygenation capacities but also high circulating velocities that promote optimum mixing conditions. Simple, low pressure fans are used rather than conventional blowers. No air filters are required. Oxygen transfer rates from 10 ppm to 150 ppm per hour and higher are feasible. Power costs range from 0.20 Kwh to 0.45 Kwh per pound of oxygen dissolved, depending on transfer rates. Construction and maintenance costs are low. For full details, write for Bulletin No. 7317 to Dorr-Oliver Incorporated, Stamford, Connecticut.

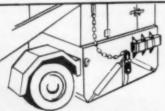


Converted DUMPSTER Containers



Sliding channels have been unlocked,

Sliding channels have been unlocked, moved back and relocked with the spring loaded pins. Container is now ready for service by the SUPER DUMPMASTER.



Sliding channels have been unlocked, moved forward and locked. Container is now ready for service by DEMPSTER-DUMPSTER LFW, GRD, ARLF or DTLE Your old DEMPSTER-DUMPSTER containers may now be converted for SUPER DUMPMASTER service with low-cost conversion kits and plans from the factory. Two types are available: (1) For permanent SUPER DUMPMASTER service; (2) For combination service by both the SUPER DUMPMASTER and your present truck-mounted DEMPSTER-DUMPSTER equipment.

The SUPER DUMPMASTER approaches 12 cu. yd. Universal Container.

Lifting forks engage Container's side channels.





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For "No Container Haul" Service

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Owners of DEMPSTER-DUMPSTER Systems who now face long haul problems due to movement of disposal areas may now convert from their present "container haul" system to the new SUPER DUMPMASTER "nocontainer-haul" system without abandoning their investment in DUMPSTER Containers.

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Automatic hopper cover increases capacity and prevents scattering of refuse. Movable hopper extensions and circular side guards prevent escape of material during dumping operations.

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Clearance arms raise Container from ground.



With hopper door open, container is rotated, emptying contents into the compaction body. It is then returned to the ground.



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The BIG DIFFERENCE is in the capacity ratings. With a "16-yard" Hyd-Pak, you get 16 yards in the main storage compartment, where refuse can be completely compressed. The three-yard loading hopper is not even counted (though it can be filled and used to transport refuse at the end of a run). Before you buy refuse collection bodies, you should see this true capacity in action. We'll be happy to arrange a demonstration. Just write or wire:

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to use effluent water as the absorbing liquid. This has been a successful operation for over a year, producing a gas of less than 60 gr. H₂S per 100 cf, which is suitable for use in the gas engines. A gas to water ratio of 2 to 1 proved adequate to produce a satisfactory scrubbing action. Of the various chemicals known to react with H2S, hypochlorite (or C12) alone was found advantageous as a "scrubber aid." The CO2 content of the gas is reduced from 35 to 25 percent, enriching the gas proportionately.

"Gas Scrubbing for H2S Removal and Methane Enrichment." By A. M. Buswell, Consultant, Gainesville, Florida. Public Works, March, 1961.

Other Articles

"Radioactivity and Digestion-new problem of the atomic era." Part 2-Research studies reveal critical concentrations of carrier-free P-32 which affect anaerobic digestion. By Werner N. Grune. Chun-Fei Chueh and Roy Peek, Professor of Sanitary Engineer-ing Research Laboratories, School of Civil Engineering, Georgia Institute of Technology. Wastes Engineering, February, 1961.

"The Position of States in Water Pollution Control." Progress, public reaction to, and needs of the state and interstate water pollution control programs. By Curtiss M. Everts, Secretary and Chief Engineer, State Sanitary Authority, Oregon State Board Health, Portland, Ore. Journal

WPCF, February, 1961.

"Estimating Sewage Treatment Plant Operation and Maintenance Costs." Public Health Service study of operation and maintenance costs of representative sewage treatment plants having a record of satisfactory operation for at least five years. By P. P. Rowan, Chief, Evaluation Section, Construction Grants Branch; K. L. Jenkins, Chief Statistician, Basic Data Branch; and D. H. Howells, Acting Chief, Construction Grants Branch, all of the Division of Water Supply and Pollution Control. Public Health Service, Washington, D. C. Journal WPCF, February, 1961. "Low Weight Plastic Scrubber In-

stallations." By F. W. Arndt, Heil Process Equipment Corp. Corrosion resistance, moderate cost and high efficiencies are among the advantages claimed for the use of plastic in packed tower shells. Industrial Water and

Wastes, Nov.-Dec., 1960.

"Detection and Monitoring of Phenolic Waste Water." By A. D. McRae, F. H. Griffiths and R. G. Lane, Imperial Oil Ltd. A method has been developed for continuous detection of phenol in plant cooling water and subsequent automatic diversion of the water from the sewer to impounding facilities. Paper presented at Seventh Ontario Industrial Waste Conference, Ontario Water Resources Commission.



Hardly! You see, Transite[®], the white sewer pipe, is made of ageless minerals—asbestos and cement. The asbestos fibers, each with the tensile strength of piano wire, reinforce the cement to form a stone-like pipe that is rugged, tough and durable. Transite is also steam-cured under high pressure, adding further to its strength, durability and chemical stability. And, being non-metallic, there's no chance of oxidation weakening its structure. What's more, Transite's high crushing strength can withstand the heavy overburden,

ground movement and earth shocks that continually challenge the ability of sewer pipe. When you add to this Transite's long lengths, tight joints and naturally smooth interior, it becomes obvious that this white sewer pipe was designed to offer greater total life expectancy.

For all the facts, write for special data file. Please indicate if you are a city official, engineer or contractor. Address: Johns-Manville, Special Sewer Data, Box 14, PW-4, New York 16, N. Y. In Canada: Port Credit, Ont. Cable address: Johnmanvil.



The Transite Pipe shown in this 23-year-old photo is still providing trouble-free service.

JOHNS-MANVILLE TRANSITE SEWER PIPE



INDUSTRIAL WASTE DIGEST



Prepared by CLAYTON H. BILLINGS, Associate Editor

Radioactivity and Sludge Digestion

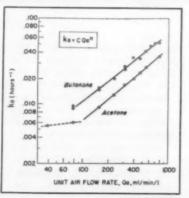
The second of two articles on the influence of radioactive materials on digestion of sewage sludge reports studies on the effect of carrierfree phosphorous 32. Sludge containing from one to 800 mc/L of carrier-free phosphorous 32 was added to a plant scale digester and the influence on gas production, reduction of volatile matter, ORP, conductivity, pH and gas quality was observed. Parallel observations were made of the results of adding plain sludge and sludge containing an equivalent concentration of phosphate in weak hydrochloric acid. From the addition of the radioactive phosphorous, ultimate gas production was decreased at concentrations of 200, 400 and 800 mc/L. Volatile acids increased: redox was unchanged up to 100 mc/L; conductivity showed adverse effects on digestion; and gas quality was unaffected up to 100 mc/L but CO. was higher in concentrations of 200 to 800 mc/L. These findings are the reverse of previous studies with phosphorous 32 in the form of KHoPO. It is assumed that in the carrier-free tests the phosphorous 32 stayed in solution, while the KH2PO4 was distributed in both solid and liquid phases of digestion. The decontamination factor in the liquid phase is 5 to 10 times greater than in the solid phase.

"Radioactivity and Digestion— New Problem of the Atomic Era." By Werne N. Grune, Chun-Fei Chueh and Roy Peek, Georgia Institute of Technology. Wastes Engineering, February, 1961.

Parameters for Petrochemical Wastes

The many products, side reactions and by products make impossible a classification of compounds found in

the waste effluents of the petrochemical industry. Characterization of the waste stream itself is therefore the alternative to be employed. The use of COD, BOD and toxicity as parameters is of some value but probably will not totally suffice. Since many volatile compounds are present in petrochemical wastes, stripping by means of diffused aeration might develop a useful parameter for comparing the treatability of various components. The degassification reaction may be mathematically expressed; the rate of change in concentration being proportional to the concentration of removable volatile component remaining at any time and to the area available for transfer divided by the total volume of fluid. A modified form of the integrated equation becomes log $C_i/C_i = -kat$, where C_i and Co are concentrations at a selected time, t, and originally, respectively. The expression ka includes the relatively immeasurable interfacial area factor. By means of bench scale studies using diffused air stripping of solutions of acetone and butanone, it was found that ka can be used as an overall transfer



Courtesy Journal WCPF

EFFECT of unit air flow rate on the
removal of butanone and acetone.

coefficient for comparing the strippability of waste components. The removal effected measured by the COD test followed first order kinetics, and ka remains constant for specific experimental conditions regardless of concentration.

"Diffused Air Stripping of Volatile Waste Components of Petrochemical Wastes." By R. S. Engelbrecht, A. F. Gaudy, Jr. and J. M. Cederstrand, Department of Civil Engineering, U. of Illinois. Journal WPCF, February, 1961.

Ordinance Reduces Treatment Plant Load

In 1955, it became evident that the City of Dallas would have to modernize its industrial waste ordinance to cope with an ever increasing treatment plant load and rapid industrialization. The first step was a survey of industries based on analytical results on samples collected and flow measurements. The results of the study showed that 20 industries were contributing 30 percent of the total solids received at the treatment plant and that the wastes of one industry had a population equivalent of 90,000, but was paying only \$500 per month service charge. These data were used to demonstrate the need for an improved ordinance to the Chamber of Commerce and the City Council. The revised ordinance, which was enacted with little opposition, sought to prevent specific corrosive and toxic wastes from entering the system and to limit the concentration of grease, suspended solids and BOD to those of "normal" sewage. The BOD and suspended solids of normal sewage were defined as 325 ppm each, based on raw sewage strength in 1956-57. A permit system was established and issuance of permits was based on agreements to pre-treat wastes to conform to normal sewage strengths or pay a

Link-Belt's creative answer to a critical problem:

"Big-city" sewage processing on a small-capacity scale

BIO-PAC

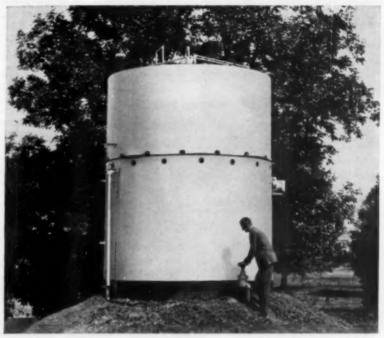
single-unit sewage treatment replaces old-fashioned disposal methods with modern, fully automatic processing

With the population spread proceeding at a rapid pace — with antipollution regulations increasing at a comparable rate — outlying areas face obsolescence of traditional sewage disposal methods.

Housing developments, industrial plants, shopping centers, schools and institutions, motels and trailer courts—all must cope with the problem of updating their methods of sewage disposal. And Link-Belt's practical answer to this problem is Bio-Pac—a modern, compact, bio-filtration sewage treatment system, designed to operate efficiently, and at low cost, in areas remote from metropolitan sewerage service.

Bio-Pac is a result of specialization—40 years of Link-Belt experience, working closely with consulting and municipal engineers, in the design and construction of industrial and metropolitan sewage treatment equipment.

As a result of this specialization, Bio-Pac represents a functional scaling down of large-capacity plant concepts. Single units are available in capacities to handle the sewage needs of 50 to 500 people. And this scaling down is a matter of size alone—no compromise of quality. Every Bio-Pac unit is a complete bio-filtration system . . . built to meet the Ten State Standards for sewage works.



Bio-Pac quality is underlined by design that delivers full two-stage treatment - featuring bio-filtration, the standard process, tested and proven in metropolitan sewage treatment plants. Even under adverse conditions, a consistently stable effluent is produced. And the system readily absorbs the shock loads which frequently upset aeration-type units. Moreover, high performance is accompanied by low operating costs. Because the Bio-Pac process is entirely automatic, it calls for only part-time care (and this by personnel who needn't be highly trained).

The remarkable overall compactness of the Link-Belt Bio-Pac offers a two-way bonus in terms of flexible installation. For example, consider the 11'-6" diameter unit illustrated above (designed to serve 150 people). As shown, height above ground is just 13 feet. Compact? Of course! But with pit installation, even greater "hide-away" possibilities can be obtained—above-ground height of only 5 feet 7 inches. It all adds up to this welcome fact . . . Bio-Pac can be made to blend with its surroundings as easily as the familiar water storage facilities.



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SANITARY ENGINEERING EQUIPMENT

UMK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago I. Sanitary Engineering Regional Offices—Atlanta, Chicago 9, Colmar, Pa., Kansas City 8, Mo., San Francisco 24, District Sales Offices in All Principal Cities. Export Office, New York 7, Representatives Throughout the World 1888 surcharge of \$0.063 per million gallons per ppm, based on the 1956-57 costs of BOD and suspended solids removal, including treatment plant costs and amortization. Additional provisions of the ordinance include accessibility to the property and the requirement of a sampling manhole. After about a year of experience with the ordinance, a definite trend toward decreasing plant loads was noticed, about seven percent less suspended solids and 5 percent less BOD.

"Experience with the Dallas Industrial Waste Ordinance." By W. D. Bentley, Industrial Waste Engineer, City of Dallas. Public Works, March, 1961.

Soft Drink Bottling

The liquid wastes of the soft drink bottling industry result from bottle washing, water treatment, washing of equipment, and houskeeping. Most of the waste load comes from the continuous rinses of the bottle washing machine. The bottling plants studied by the Sewage Disposal Section of the City of Cincinnati discharged an average of 10,700 gal. of waste-water, 30.8 lb. of 5-day BOD and 24.1 lb. of suspended

solids per 1,000 standard cases. The pH values approximated 11.0 and the total alkalinity average 290 mg/L. Most of the BOD originates from the draining of leftover drink from used bottles. It may be economically feasible to dispose of these liquids separately by reclamation for other usage. Water is conserved by reusing part of the final rinse water as pre-rinse. If the spent pre-rinses containing molds. straws, cigarettes, and other rinses from bottle washing containing labels are passed through adequate screening devices, the amount of suspended solids discharged may be greatly reduced. The compartments containing alkaline detergent cleaning solution are generally dumped only when it is no longer feasible to add proper chemicals for regenerating the used solutions. Soft drink bottling plants are generally located close to centers of population. Discharge to municipal sewers appears to be the best means of waste disposal.

"Wastes from the Soft Drink Bottling Industry." By Ralph Porges and Edmund J. Struzeski, Jr., R. A. Taft Sanitary Engineering Center. Journal WPCF, February,

Equitable Charges For Waste Treatment

When a city has to arrange charges for treating the wastes of a single industry, more difficulty is likely to be involved than with multiple industries. Contractual arrangements are often made, but a contract in which the city guarantees successful waste treatment does not necessarily keep the industry blameless for pollution. However, two-part arrangements have been in force many years without being especially burdensome. Financing debt service and operation costs by assessing sewerage service on the basis of water consumption may be unfair or inequitable for industries, because strength of wastes is not considered. Surcharges may be computed for strong wastes but should be carefully done. In considering that the needed total annual revenue should be derived from users of the sewer system and properties in proportion to the amount each causes to be spent, the following should be fundamentally observed: 1) A share of the cost of designing for future capacity should be contributed by property; 2) the costs for capacity and operation due to infiltration should be borne by properties and not users; 3) grit removal cost



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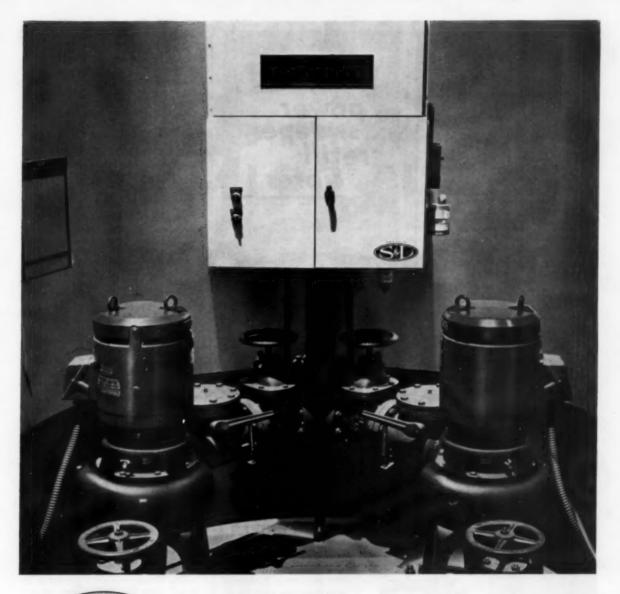
vaunted American manufacturing industries could not operate without the valves which control their water supply and the fire hydrants which protect them from fire.

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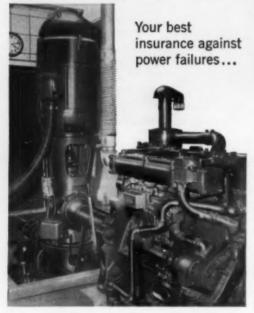


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should be assessed against properties, but that for grit washing against users; 4) pumping station annual cost and cost of capacity should be divided between users and properties; 5) because sludge digestion costs are increased by accumulation of grit in the tanks, part of the cost should be allocated to properties.

"Fair Sewer Service Charges for Industrial Wastes." By Kenneth V. Hill, Greeley and Hansen, Chicago, Ill. Jour. WPCF, February, 1961.

Other Articles

"Simplified Test for Hexavalent Chromium," By B. L. Goodman, Chemist, Warren, Mich., Sewage Treatment Plant. A method is described for using a single stable reagent in powder form rather than relatively unstable liquid reagents. Water and Sewage Works, February, 1961.

"Disposal of Pulp and Papermill Waste by Land Application." By I. Gellman and R. O. Blosser, National Council for Stream Improvement. Results of 18 mill studies are summarized together with background material on physical characteristics of the soil, microbial activity, organic decomposition and current irrigation practices. Compost Science, Winter, 1961.

"Alumina Reclaimed from Refuse Mud." By Charles J. Dick, Fuller Co. Refuse mud from filtering operations in the refining of alumina from bauxite ore contains small amounts of alumina oxide. Reclamation is possible by returning the mud through a refining process and using special grate coolers. Industrial Water and Wastes, January-February, 1961.

Storm Water Control at O'Hare International Airport

The Chicago-O'Hare airport is located near the headwaters of two small creeks, the channels of which have limited flow flow capacity. The high rates of storm water runoff from runways, taxiways, aprons and parking areas present a problem. This has been overcome satisfactorily by using a large borrow pit, from which fill materials for the runways, apron and parking areas were obtained, as a stormwater detention reservoir. This borrow pit will appear, when construction is completed, as a permanent lake of about 75 acres area. Its water surface will fluctuate in level during dry and wet weather periods. Sufficient storage will be provided to hold the peak runoff from the maximum storm of record with only a moderate amount of outflow. A special outlet control structure will minimize downstream flooding.

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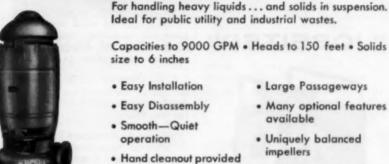
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NEWS OF ENGINEERS

PAUL R. SCREVANE. Commissioner. Department of Sanitation, New York City, has been designated as Deputy Mayor. He will be succeeded as Commissioner by FRANK LUCIA who has been chief of staff of the Department.

RALPH J. BLACK, sanitary engineer, who has been with the California Division of Vector Control, has joined the Public Health Service. He will conduct solid wastes engineering activities, assisting regional offices and cooperating with national organizations in this field.

A. G. COCHRAN has been made a partner in the consulting engineering firm of Rackoff Associates, Columbus, Ohio.

MURRAY G. ALBERTSON has opened an office as consulting engineer at 14 Englewood Road, Rowayton, Conn. He will specialize in water supply and sewage and industrial waste. A 1949 graduate of Swarthmore, he is a licensed professional engineer in three states.

HAROLD W. HANSEN has been appointed senior planning engineer by the Portland Cement Association. An engineering graduate in 1940 from the University of Minnesota, Mr. Hansen has had a wide experience in the highway and related fields.

S. N. PEARMAN succeeds the late Claude McMillan as chief highway commissioner for South Carolina.

WARREN W. PARKS, Village Manager of Indian Hill, O., since 1943, has been named Engineer of the Year by the Technical and Scientific Societies Council of Cincinnati. Ohio. A graduate of Worcester Polytechnic Institute, Mr. Parks has had a wide experience in civil and public works engineering. Mr. Parks has three sons, all active in civil engineering.

J. J. CORBETT is now chief highway engineer of Missouri, succeeding Rex Whitton, appointed federal highway administrator. M. J. SNIDER is assistant chief engineer and L. F. BECKETT is chief of the construction division

MARSHALL S. WRIGHT, JR., is manager of the newly opened Washington, D. C., office of Lockwood, Kessler & Bartlett, Inc., consulting engineers of Syosset, N. Y.

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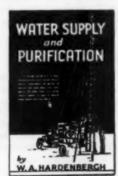
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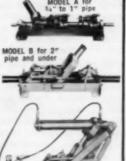
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Selection of Power Plant Sites

BRUCE J. ENNIS

Associate,
Burns & McDonnell Engineering Co.,
Kansas City, Missouri

HEN A NEW thermal generating plant is to be added in a power system, it becomes necessary to determine the best site on which the plant is to be located A brief discussion of some of the factors to be considered may be helpful in selecting the particular site which will best serve the needs of the new plant. Factors applicable to most plants are as follows:

Adequate Area with Acceptable Topography

The ideal plant site will be reasonably level and must have room not only for the initial installation but also for the expected ultimate development of the plant including space for all necessary satellite buildings, the coal handling and storage, fuel oil tanks, railroad yards, etc.

Even where natural gas has been abundant in the past, it seems questionable if any new plant should be laid out without allowing space for either present or future coal handling. The area usually assigned for coal storage will permit storage of enough coal to operate the plant from 60 to 90 days in case of emergency.

Economical Fuel Supply for Life of Plant

One very important factor to be considered in selection of a plant site is the cost of fuel at the proposed location not only for the present, but also for the future. Low cost interruptible natural gas may be available for an appreciable period of time in certain locations while not at alternate ones. The cost of coal per million Btu's may vary appreciably between sites, depending upon mine location and delivery costs to the site. Delivery is usually by rail but may be by truck or barge or even directly from the mine mouth by conveyors.

Usually mines are not at the system load centers. Therefore, if a plant is located at the mine it will be necessary to transmit the energy to the load center. Here the added

cost of power transmission must be weighed against the fuel saving cost. As fuel is the most costly single item in the production of electricity, the determination of fuel cost at each of the plant sites under consideration is of particular importance.

Suitable Circulating Water Facilities

A power plant requires large quantities of circulating water for disposing of the heat given up in the power plant condensers. The choice of a site with an economical circulating water supply is another important factor. The amount of cooling water required will vary with the size of the unit, its operating pressure and temperature, and the circulating water temperature. Usually from 0.5 to 1 gpm is required per operating kw, of which about 1 to 1½ percent will be evaporated in cooling the circulating water whether it is recirculated or not.

The ideal source of circulating water is a stream with adequate flow so that it will not require recirculation or a lake with an adequate surface cooling area. There are not many locations which have the other necessary requirements where natural river flow or lake surface is adequate. Therefore, in many locations the circulating water system must be developed and its capital and operating cost compared with costs at other locations. In some cases a dam may be constructed to form a lake with adequate surface cooling. A very rough rule to determine the approximate area for such a supply is that one acre of water surface will cool circulating water for approximately 1,000 kilowatts operating at 50 percent load factor. The lake formed by such a dam must have a sufficient drainage area back of it to supply both the evaporation caused by the operation of the power plant and also to supply the natural surface evaporation. It must have enough water storage and surface so that after a prolonged drought period it will still have adequate cooling area.

Oftentimes the most economical way for developing cooling water is to install cooling towers. Where

cooling towers are determined to be the most economical source of circulating water, the site must be such that the towers can be located to prevent nuisance fogging of the surroundings and to permit the proper sweeping away of saturated water vapors. While the cooling tower often has the lowest initial capital cost requirement, it usually is more costly to operate. It often requires higher pumping heads and in addition requires the use of considerable fan horsepower. A cooling tower may take from 1/2 to 1 percent of the total generating unit output to supply its added pump and fan horsepower.

A cooling tower also has makeup water requirement beyond that required for evaporation. This is to supply tower basin blowdown and drift losses which can amount to one-third or so of the natural evaporation losses, depending on the chemical content of the makeup supply. Cooling towers usually are also subject to greater maintenance and to shorter life than other types of circulating water facilities.

Thus the capital and operating costs for circulating water facilities may vary greatly between sites and may be a decisive factor in the selection of a power plant site.

Transportation Facilities

Obviously a power plant site should have suitable access roads into it and also rail facilities to supply it. The cost of constructing such access facilities into the power plant is one of the factors which must be considered. The variation between sites may be appreciable.

Proper Foundation and Subsoil Conditions

The subsoil condition at the site and its suitability for foundations is a most important factor. If rock is too near the surface, then the cost of excavation may be high. If the permissible soil loading conditions at the site are low, then it may be necessary to drive piles or to pour piers or in other ways provide adequate support for the power plant structures. Sometimes the site may be such that high ground water level may result in high dewatering

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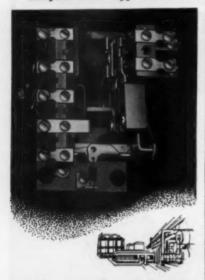


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costs during construction and cause expensive basement design against flotation of the power plant structure. Thus, the condition of the subsoil and the resulting cost of constructing the foundation and basement must be carefully compared between sites.

Cost of Utilities

A power plant requires a source of good domestic water supply for sanitary and other purposes, a means for disposing of sanitary sewage and wastes, must have communication facilities, and must have adequate fire protection. At some sites, a city water and sewerage system may be readily available as well as fire protection. If not, these must be constructed on the site and the cost of building and operating them determined and compared between sites.

Relation to Electric Load Center

If all other factors are equal, the new plant should be located at the electrical load center. This is seldom the case and the plant, because of site availability or other factors, is often located at some distance from the load center. Therefore, one of the cost considerations for the selection of a plant site is the cost of transmitting the power from the new plant to the electric load center. This involves both the cost of constructing the necessary electric lines and also the cost of operation.

Waste Disposal

Usually, 7 to 20 percent of the coal burned is ash. Provision must, therefore, be available for the disposal of the ash produced. Occasionally this ash may be sold in the form of fly ash dust, but more often it is necessary to convey the ash to a dump area. The dump area may be low waste ground areas or ravines which can be filled. Sometimes the ash fill will ultimately provide usable land area which may be reclaimed.

Special Conditions

Plants at certain sites may require special provisions for mitigating certain factors which may be objectionable at one site and not at another. For instance, noise may be a factor at certain sites and special provisions must be made for reduction of noise. At others, coal dust and fly ash may require costly treatment.

Comparison of Sites

The selection of a power plant site would be a simple matter if

each of the factors discussed above showed best for that site. However, this almost never occurs as some sites will be better in one respect and not so good in another. It thus becomes necessary to evaluate these and to choose the site which rates the highest when all of the various factors are considered.

Of the various factors mentioned, some may be evaluated on a dollars and cents basis, but others must of necessity be evaluated on the basis of judgment only.

After comparative capital costs have been determined, fixed charges resulting from these capital costs are calculated. Likewise, comparative operating costs must be determined for plants at various sites. The lowest cost per kwh will result from a plant located at a site having the lowest sum total of comparative fixed charges and comparative operating costs and this site will be best unless the item of judgment may over-rule the straight economic consideration.

Rudolfs Research Conference

Public health hazards of microbial pollution of water will be the topic of discussion at the Rudolfs Research Conference to be held at Rutgers University, New Brunswick, N. J., June 19-21. Frank B. Elder of the American Public Health Association will preside at a panel considering the public health problem, with discussion centering on pathogenic microorganisms in water and the incidence of disease. A panel on indicator organisms and their significance will be presided over by H. Heukelekian of Rutgers University. C. N. Sawyer of the firm of Metcalf and Eddy will preside at the discussion of the theory, objectives and accomplishments of disinfection. The conference summary will be presented by Bernard Berger of the Robert A. Taft Sanitary Engineering Center. Further information is available from Dr. H. Heukelekian, Chairman of the Department of Sanitation at Rutgers.

International Soils Conference Features European Tour

A five week study tour which will provide attendance at the Fifth International Conference on Soil Mechanics and Foundations during visits to important civil engineering centers in ten countries in Europe will leave New York on July 15. Details are available from Study Abroad, Inc., 250 West 57th St., New York 19, N. Y.

THE STANDARD HIGHWAY PATTERN FOR CITIES

ROBERT J. DAIUTE

THERE ARE several points of view on the proper location of major highways at cities. Those who hold the different views often present different proposals. One may be called the engineering view. It is oriented to locating and designing the roads so as to expedite the traffic flow, serve the desires of highway users and, at the time time, hold down the cost of right-of-way, construction and maintenance.

A second view assays the economic benefits of alternative highway locations. There are two phases to this approach. One phase measures cost savings to drivers, e.g., the reduction of gasoline expenses when stop-and-go driving is eliminated. The other estimates benefits to the local economy, e.g., increased business sales from reduced traffic congestion.

Another point of view is held by mayors, councilmen and other elected officials. These men are interested in the influence of highway locations on their political careers and the electorate. More specifically. they are interested in effects on business sales and profits, values of taxable property and availability of housing. Additional complexities are introduced by the interest of state and federal governments in highway locations in cities.

Public officials receive advice from professional planners who possess yet another point of view. This view is concerned in particular with social and esthetic results. For instance, planners advise against bisecting residential neighborhoods because they wish to preserve homogeneous land use.

It is desirable for the interested parties holding the different viewsthe engineering, economic, political, and social and esthetic views-to recognize and take into account the viewpoints of one another. This practice is required to reduce misunderstandings and disputes. More is required than for the parties to learn merely to get along together. Beyond this initial step is the need for a study conducted on a continuing and informal basis by the interested parties of each city. Only in such a way will all the legitimate points of view gain recognition in a unified highway system that is adapted to the needs of the city and its traffic flows. Coordination of the fiscal plans and organizations of different units of government is usually required as well.

The Standard Pattern

Such a joint study may develop a plan similar to the standard pat-

What is the standard pattern of main highways at cities? It is a unified system of major routes which includes three parts: 1) An inner loop, or belt, around the central business district, 2) radial routes extending from the inner loop to an outer circumferential and 3) the outer circumferential itself. The pattern has the form of a wheel with the inner loop corresponding to the hub; the radials to the spokes; and the outer circumferential to the rim. The standard pattern is a widely-accepted idea of the desirable highway system for a city. It has guided the locating of highways still in the design phase and it is currently being implemented in stage construction at several cities such as Fort Worth and Cleveland.

The adaptability of the pattern to a city's needs and resources helps to account for the favor shown for the pattern. The pattern can include highways with all intersections at grade and no control of access. Or the pattern can call for modifications of intersecting streets through the construction of dead ends and cul-de-sacs to eliminate some intersections at grade. Higher design standards for the pattern can be adopted to provide expressways (four-lane highways with some intersections at grade) or freeways (like expressways except with limited access and no intersections at

Because there is widespread agreement on the standard pattern, it is useful in evaluating existing and proposed highways in cities. Other things being equal, the greater the deviation of the actual (or proposed) pattern from the standard pattern, the greater the degree of deficiency of the actual (or proposed) system. This is the sense in which the standard pattern is a standard.

However, the standard pattern is also a pattern. It does not serve to force all city systems into one rigid (Please turn to page 180)

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The Inner Loop

The central business district usually contains three sections: Retail core: office buildings and banks: and cultural features such as theatres. The inner loop distributes traffic to these three sections. Expediting the traffic flow of motor vehicles driven by businessmen, clerical workers and shoppers is not the entire answer to traffic congestion in the central business district however. It is necessary to provide convenient vehicle storage as well. The inner loop is a strategic location for parking facilities. Cruising through the business district is prevented because drivers are intercepted before they traverse the district. Motorists can walk or take public transportation to the retail core. Further relief is afforded central business district congestion by the inner loop since it also serves as a by-pass of the central business district and as a distributor of traffic among nearby sections outside the district.

It would appear that the inner loop can have a most beneficial effect on the central business district. It reduces congestion in several ways. It makes the central business district more accessible because radials connecting to it bring traffic in from adjacent sections and the suburbs.

The Radials

Radial routes bring traffic flows on a direct route to the central business district and enable outbound traffic streams to move more swiftly. While there has been a rise in outbound traffic as business activity in the suburbs develops, the main flow of traffic continues to be between the central business district and the city neighborhoods.

The radials will carry both major and minor flows and avoid the dispersal of such traffic along a large number of routes which should be kept for strictly local use. They serve to delineate residential neighborhoods and insulate them from areas with different land uses in the city. Radial locations can be tied in to zoning regulations. Furthermore, radials provide direct routes to the outer circumferential for distribution among suburbs and intercity travel. Radials may connect the

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urban system and the inter-regional system where an Interstate highway bypasses the small city.

The outer circumferential enables through traffic to go past the central business district and nearby sections without going into them. Also, the outer circumferential is a route for trips with an origin and destination in locales traversed by the circumferential. This is the most frequent type of trip on Route 128, a typical circumferential around Boston, Massachusetts.

Experience with circumferentials indicates that they are considered ideal locations for manufacturing firms and shopping centers, especially near interchanges. Manufacturers find that a straight-line flow of production in a one-story building, accessibility to product and labor markets and attitudes of management, all make a circumferential an economical location for them. Shopping centers can give free parking on relatively cheap land and still be accessible to a motoring clientele which has high purchasing

Mass Transportation

The standard pattern has the added virtue of being adaptable to mass transportation and urban renewal programs. Many cities need more radial routes so that express busses can furnish fast mass transportation in which a large number of people can be carried in a small number of motor vehicles, thereby relieving congestion and pressure on parking facilities. Some cities may find it expedient to locate rapid transit lines in the median of radial routes. A mass transit system is generally a necessity even though highways are improved to high standards. It appears then that the standard highway pattern for cities may serve as a useful guide in locating new highways to achieve benefits of an engineering, economic, political, social and esthetic nature.

Cooling Degree Days and Summer Water Use

Ames, Iowa, reports that "cooling degree days" above 65°F provides a surprisingly consistent indication of summer water use for air conditioning. The cooling degree day is computed as in the following example: Maximum temperature for the day 95°; minimum for the day 75°; mean temperature 85°; cooling degree day 85-65 = 20°.

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EQUIPMENT NEWS

Crawler Tractor



Equipped with a six-cylinder, DT-691 turbocharged diesel engine, the International TD-20 (201 series) crawler develops 140 engine horse-power at 1,550 rpm. The TD-20, boasting six-speed, full-reverse transmission, has a drawbar horse-power of 113. Shipping weight is 29.685 lbs

A 50 percent increase in torque rise to handle larger overloads is

accomplished through use of allaltitude, modern turbocharging. The TD-20 is equipped with a new drytype air cleaner, which has a 99.8 percent efficiency in filtering the increased air volume.

International Harvester Co., 180 North Michigan Ave., Chicago 1,

Circle No. 4-1 on the convenient reply card facing page 34.

Rest Area Chemical

A chemical formulation to end rest area privy odors, Sani-Septic Concentrate offers landscape architects, park officials, sanitary engineers, highway, mining, lumbering, and industrial maintenance personnel a solution to the rest area odor problem by destroying the bacteria that are the source of odors. It also prevents the growth of fungi that speed decomposition of waste materials and resulting odors.

Werley Chemical & Supply Co., 1505 Broadway, Cleveland 15, Ohio. Circle No. 4-3 on the convenient reply card facing page 34.

Sieve Shaker

A sieve shaker suitable for use in the testing and grading of aggregate materials such as sand, gravel, asphalt and concrete, the Testshaker is adapted for use either in the laboratory or in the field.

The shaker will handle either 8" or 12" diameter sieves, is small, light weight, quiet operating, and can be used for either manual or electric operation.

Testlab Corp., 3398 N. Milwaukee, Chicago 41, Ill.

Circle No. 4-4 on the convenient reply card facing page 34.

Dry Copier

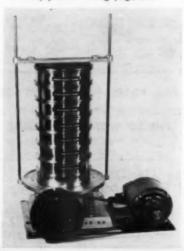


Diafax, automatic office equipment that produces completely dry, permanent, positive black and white copies in seconds uses the electrostatic principle of transferring images. The original document to be copied, including bound volumes up to legal size, written, drawn or printed in any color, is placed on a "reading" glass; a button is pressed and in seconds the dry copy is ready.

The unit requires no loading of developer powders or maintenance. It operates on standard current and may be used in any office with complete safety.

Photorapid Corporation, 236 Fifth Ave., New York 1, N. Y.

Circle No. 4-2 on the convenient reply card facing page 34.



Power Tamper



The Kelley Model 18 KT Power Tamper is recommended for use next to foundations and walls, around culverts, piling and piers, in pipeline trenches, and on subbases for road widening jobs. Tamper also can compact asphaltic masses by using a special exhaust heater attachment on the shoe.

The unit is self-propelled, moving forward up to 80 ft. per minute and tamping up to 400 sq. ft. per hour. An 18" wide shoe is standard but a 24" also is available.

Kelley Machine Div., 285 Chicago St., Buffalo, N. Y.

Circle No. 4-5 on the convenient reply card facing page 34.

Airless Pump

This compact, light-weight airless pump, is suitable for maintenance work, industrial maintenance and product finishing. The unit consists of lid, five gallon material container and handle. The 26-1 ratio pump will handle all conventional paints, using the standard airless gun fitted with medium production caps, and will operate with air pressure produced by as small as 1-hp compressor.

Accessories offered with the pump include a regulator assembly with gauge and blow gun, recommended for use with non-regulated air, a material strainer to be attached at the pump outlet, and a swivel connection between the fluid hose and gun for flexibility in spraying.

The Devilbiss Co., Toledo, Ohio. Circle No. 4-6 on the convenient reply card facing page 34.

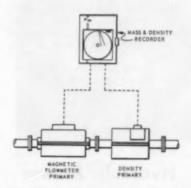
Measurement System

This mass flow measurement system is obstructionless, and completely unaffected by viscosity, pressure, temperature, or piping configurations. The total system has an accuracy of up to \pm 1.5 percent and is ideal for use in the water and waste industry for accurate and efficient control of the consistency of sludge.

One element in this system is the magnetic flowmeter which measures the volume flow rate. The other primary element is a radiation density detector which, like the magnetic meter, is obstructionless.

Fischer & Porter Co., 792 Jacksonville, Rd., Warminster, Pa.

Circle No. 4-7 on the convenient reply card facing page 34.



Signals from the two primary elements are multiplied in readout instrument.

Gutter Broom

This premade gutter broom section is bolted between the housing and a retaining ring with six bolts. Using a socket wrench, worn gutter broom sections can be removed and a new section bolted in place in 10 to 15 minutes.

The premade gutter broom sections are filled with .041 round crimped brush wire. The housing is made of aluminum. Refills are shipped ready for use. The sections are standardized and will fit almost all self-propelled sweepers.

Newark Brush Co., 260 Michigan Ave., Kenilworth, N. J.

Circle No. 4-8 on the convenient reply card facing page 34.

Safety Vest



The Safety Flash Vest is made of a vinyl coated heavy cotton base in a fluorescent orange-red with contrasting wide luminescent white stripes. Designed to fit over any type of clothing, it is perforated for coolness and comfort. Secured by heavy cloth tapes through elastic cloth loops, complete freedom of movement is assured. It is plainly visible either day or night.

Warren-Knight Co., 136 North 12th St., Philadelphia 7, Pa.

Circle No. 4-9 on the convenient reply card facing page 34.

Concreter

An all-purpose concrete placing machine, the Uni-Cretor, is a high production pneumatic concrete placing machine, capable of wet gunning, concrete placing, hoisting and placing mortar and grout, and high and low pressure grouting.

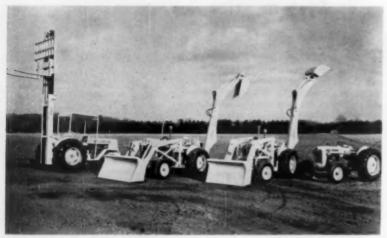
Compact in design, the Uni-Cretor weighs only 2,200 pounds, is 76 inches long, 82 inches wide and 58 inches high. It is powered with a 56 hp Air Cooled Wisconsin Engine.

Air Placement Equipment Co., Kansas City, Mo.

Circle No. 4-10 on the convenient reply card facing page 34.



Industrial Tractors



Two series of Ford industrial tractors—the "2000" and "4000"—and a front-mounted loader have many features in common, including a cast steel one-piece front axle, power steering, foot throttle, comfort seat, and rugged rear axles. Both also use four-cylinder, in-line, overhead-valve engines and are available with diesel, gasoline, and LP-gas fuel options.

The industrial loader, designated the "720", has a 2000-pound lift capacity and 4000-pound breakaway capacity, and is recommended for installation on the "4000" series tractors.

Depending upon which bucket is used, the loader has a maximum dump height of 8 feet 5½ inches and a reach into truck bodies of 31½ inches.

Tractor and Implement Div., Ford Motor Co., Birmingham, Mich.

Circle No. 4-11 on the convenient reply card facing page 34.

it hits a rigid obstruction. The cutter bar is reengaged without the operator leaving his seat.

If an object jams the knife, the operator can clear the jam by reversing the hydraulic motor. The cutter bar can be raised from ground level to a full 15 inches and lowered without tilting and with no knife slowdown. The cutter bar remains horizontal and continuous to mow efficiently while maneuvering. This feature is particularly important for cutting over curbs, traffic islands, etc. Mowers are available with a 5, 6 or 7 foot cutter bar.

A. C. Anderson Corp., Dept. 121, Wildwood, N. J.

Circle No. 4-13 on the convenient reply card facing page 34.

Earth Shredder



For landscape and turf contractors, road builders and sewage plant operators, the Paul Bunyan "360" shredder offers a compact, portable, complete soil processing plant. Equipped with a 70-hp engine and a 9' wide hopper, the unit has a shredding capacity up to 120 yds. per hour.

Capable of taking a charge of 2 cubic yards from a bucket loader or drag line, the feeding hopper is unloaded by a flighted belt that moves the material at a steady rate up to the shredding mechanism. Stones and other refuse are automatically ejected from shredder into a refuse disposal chute, and are piled outside the area of the machine or in disposal equipment

placed beneath the chute.

Dept. P. B., Royer Foundry &
Machine Co., 158 Pringle Street,
Kingston, Pennsylvania.

Circle No. 4-14 on the convenient reply card facing page 34.

Crawler Shovel

This series of crawler mounted machines in the 3/8 to 1/2-yard capacity class features a tractor type undercarriage.

The crawler has a heavy-duty, electrically-welded car body, precision swing table, full vision cab, and controls with underfloor mounting. Several gasoline and diesel engines are available as standard equipment.

Quick-Way Truck Shovel Co., 2401 E. 40th Ave., Denver, Colo.

Circle No. 4-12 on the convenient reply card facing page 34.

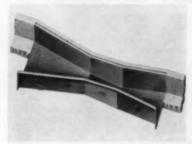


Hydraulic Mower



This tractor-mounted hydraulic mower featuring positive knife speed and instant cutter bar control is designed especially for continuous heavy duty highway and industrial tractors. Full power is provided for instantly raising, lowering, or angling the cutter bar from -45° to +90° without knife slowdown. A heavy-duty breakaway latch automatically trips and lets the cutter bar swing clear whenever

Flume Liner



A one-piece, precision-molded Parshall Flume Liner, accurately duplicating Parshall Flume proportions is constructed of polyester resin re-inforced with fibreglass. It is available in sizes from 3-in. (10 gpm) to 8-ft. (210,000 gpm).

The flume liner will tolerate a high degree of submergence and will handle fluids containing settleable solids with no deterioration, being corrosion-proof. Head loss is low, making it suited for liquids flowing in open channels.

B-I-F Industries, Inc., P. O. Box 276, Providence 1, R. I.

Circle No. 4-15 on the convenient reply card facing page 34.

Utility Dozer

The Ulrich Model 6H Varidozer is a completely different utility bulldozer with a wide range of hydraulically-controlled blade positions. The unit can be changed in seconds from a straight blade to an angle blade, forward "V", re-



verse "V", tilt blade, or to any combination of these positions. The entire cycle of positions is controlled by four hydraulic levers mounted beside the tractor seat, giving instantaneous finger tip control of the blade, under full load or empty, while the machine is moving.

Ulrich Manufacturing Co., Roanoke, Ill.

Circle No. 4-16 on the convenient reply card facing page 34.

Core Drill

A heavy-duty, truck-mounted combination core drill and auger designated as the Acker SP handles all types of diamond bit coring and auger boring for soil sampling, hollow stem augering, geophysical and geological exploration, water wells, and foundation borings.

Features include a four speed cathead hoist, built-in reverse, four speed transmission and hydraulic drill head. The unit is self-contained with its own power plant, built-in tool bins, water tank and hydraulically operated mast and leveling jacks.

Acker Drill Co., Inc., P. O. Box 830, Scranton 2, Pa.

Circle No. 4-17 on the convenient reply card facing page 34.



Augers to 300 feet, drills to 1500 ft. for holes up to 24 inches in diameter.

Pickup Truck

For 1961, the Studebaker Champ features a 110-hp six-cylinder overhead valve engine and a welded box measuring 70% inches wide and 49 inches between wheelhouses. Inside lengths of the boxes are 99 inches and 78% inches for 122-inch and 112-inch wheel base models, respectively.

Studebaker-Packard Corp., South Bend, Ind.

Circle No. 4-18 on the convenient reply card facing page 34.



Service Ladder



The Alco-Lite Rolling Service Ladder is a self-supporting extension ladder unit requiring no secondary support. Mounted on a rigid, welded steel frame that is equipped with 8" semi-pneumatic wheels and hand-retractable, swivel type front casters, the ladder moves freely over rough floors. A cam operated device locks steel rods into the bottom gusset-plate rung openings to hold the ladder securely in the upright position. Outriggers, which fold out of the way when not in use, extend to both sides to provide added side stability when needed. Hand rails and a lineman's plastic belt attached to the top of the ladder are added safety features.

Aluminum Ladder Co., Special Ladder Dept., 57 W. Darlington St. Ext., Florence, S. C.

Circle No. 4-19 on the convenient reply card facing page 34.

Weed Killer

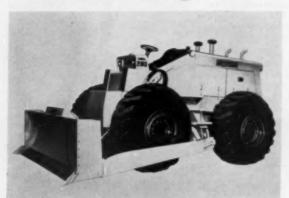
A deep penetrating non-toxic weed killer called Pentex contains a penetrant additive that quickly carries the material below the surface of the soil and into the roots.

A non-selective weed-killer, Pentex is sprayed on the surface of the earth, absorbed in the roots, permanently destroys the entire plant and leaves a long-lasting residual effect which discourages new growth. One gallon diluted with 9 gallons of water covers from 150 to 200 square feet.

National Chemsearch Corp., 2417 Commerce, Dallas 26, Texas.

Circle No. 4-20 on the convenient reply card facing page 34.

Diesel Engine



Brush Chipper



A 290-hp General Motors diesel engine, available as optional equipment on the Michigan Model 280 Tractor Dozer, is designed to increase the tractor dozer's flexibility and production. It features a two-stroke engine cycle, unit injector fuel system, and maximum parts interchangeability. The other pow plant available is the 262 hp Cummins NTO diesel.

Driven through the power train,

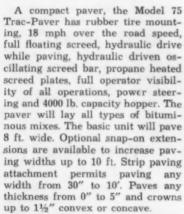
Asphalt Paver

the unit has a top speed of 28 mph in forward or reverse. The power shift transmission is the full reversing type with selector for two or four-wheel drive, rear-wheel steering and a front axle with locking type differential.

Construction Machinery Div., Clark Equipment Co., Pipestone Plant, Benton Harbor, Mich.

Circle No. 4-21 on the convenient reply card facing page 34.

Auger



Trac-Machinery Corp., Nunda, N. Y.

Circle No. 4-22 on the convenient reply card facing page 34.





The Hole King, a hole digger equipped with a nine-inch auger, and designed to dig to a depth of 46 inches, attaches to all three-point lift tractors. Fast hitch and snap coupler hitches are also available. A rigid guide lever within reach of the tractor operator enables the user to dig a perpendicular hole, or one at an angle. Cutting edges on the auger are made of high carbon steel and are replaceable as are all other parts subject to wear.

E. L. Caldwell & Sons, Inc., P. O. Box 2050, Corpus Christi, Texas.

Circle No. 4-23 on the convenient reply card facing page 34.

Two accessories on Fitchburg Chippers include a safety stop switch located at the top of the feed apron which stops the Chipper within seconds for added safety, and a second switch, also located at the rear for easy use, gives immediate control of the motor without having to move from the feeding position. This solenoid switch will idle the motor between actual feeding operations, thus decreasing gasoline consumption, reducing engine wear, and making quieter operation possible.

Fitchburg Engineering Corp., Fitchburg, Mass.

Circle No. 4-24 on the convenient reply card facing page 34.

TV Monitor

This series of closed circuit television monitors is equipped to fill the wide range of needs in the municipal and commercial transportation surveillance-control field. The monitors are capable of three times the picture quality of home sets, but are simpler to maintain and adjust. They operate with any standard monochrome camera. Because of their high picture detail—an 800-line minimum horizontal

71



resolution — the monitors take full advantage of camera performance.

The monitors are suited to applications in the transportation and other municipal and commercial fields including monitoring of meters and other equipment in municipal water and sewage treatment plants, traffic control of urban freeways and safety surveillance of remote or isolated areas.

For maximum flexibility in filling varied specific needs in closed circuit television, General Electric provides the monitors in cabinets or rack mounting.

General Electric Communication Products Dept., P. O. Box 4197, Lynchburg, Va.

Circle No. 4-25 on the convenient reply card facing page 34.

Pocket Radio



A pocket size "Walkie-Talkie" citizen's band radio weighing 18 ounces and with a range of one mile under normal operating conditions, the Lafayette HE-29, crystal controlled with a super heterodyne receiver, features push-to-talk operation. The HE-29 uses eight batteries with a life of about 70 hours. It has a 46-inch telescoping antenna which will transceive up to seven miles under optimum conditions.

The radio may be operated without FCC license. It may also be used as an integral part of any Class D radio system.

Lafayette Radio Electronics, Jamaica 33, N. Y.

Circle No. 4-26 on the convenient reply card facing page 34.

Aerial Boom



The Series 8000 Squirt Boom, can be operated by one man from controls located in the bucket. It is useful for re-fusing transformers, group lamp replacement work, mid-span taps, installing electric service, and street light and signal work.

Mounted on a 60" CA, 14,000# GVW chassis, the fiberglass bucket, yoke and boom can withstand a 73,000-volt (A.C.) bucket-to-ground test. The fiberglass boom, by means of a double-acting hydraulic cylinder, extends 10' 7" from the end of the main boom and can be stopped for work at any point in its travel.

Holan Corp., 4100 West 150th St., Cleveland 35, Ohio.

Circle No. 4-27 on the convenient reply card facing page 34.

Iron-Body Valve

An hub-end iron-body valve for use with concrete pressure pipe, the M & H hub-end valve employs large O-ring gaskets to connect the valve hubs to the concrete pipe. This valve



eliminates the need of adapters when installing valves in a concrete pipe line, saving installation and adapter costs.

The hub-end valve for concrete pipe meets AWWA standards and is furnished in sizes 12" through 42". The valve gaskets are the same as the gaskets used for the concrete pipe line joints. Hydrostatic tests and field installations show the joint to be leakproof.

M & H Valve and Fittings Co., Anniston, Ala.

Circle No. 4-28 on the convenient reply card facing page 34.

Centrifugal Pump

A series of seven air-cooled, diesel powered, self-priming centrifugal pumps is available with 2", 3", 4" and 6" openings. Capacities range from approximately 15,000 to 90,000 gallons per hour. The diesel engines are 4-cycle, air-cooled, crank-start types with electric starters as optional equipment. Controlled weights throughout the over-all design, per-



mit the use of high-speed trailers with 4.00 x 12 and 5.90 x 15 pneumatic tired wheels and tow tongues. Skids and conventional wheel mountings are also available.

Rice Pump & Machine Co., Belgium, Wisconsin.

Circle No. 4-29 on the convenient reply card facing page 34.

Modern Cabinets

A design for the Sparling line of recording instruments emphasizes clean contemporary lines for all cabinets. Simplicity of appearance will fit in with modern station arrangements, while at the same time complementing any existing instrument layout in plants already in use. The finish on the cabinets of the pedestal and wall mounted units is gray hammertone. Panel mounted units are black satin.

Hersey-Sparling Meter Company, 225 N. Temple City Blvd., El Monte, California.

Circle No. 4-30 on the convenient reply card facing page 34.

INDEX OF ADVERTISEMENTS

| Alabama Pipe Co 50 | Fairbanks Merse & Company 55 | Pacific Flush Tank Co 157 |
|--|---|--|
| Alco Oil & Chemical Corp 73 | Federal Sign & Signal Company 141 | Palmer Filter Equipment Co 141 |
| Allis-Chalmers 41 | Fitchburg Engineering Corp 126 | Pfaff & Kendall 18 |
| Aluminum Company of America 10 & 11 | Flexible Inc | Phelps Dodge Refining Corp 150 |
| Amchom Products, Inc 40 | Flintkete Co. (Orangeburg Div.) 173 | Pittsburgh-Des Maines Steel Co 58 |
| Amercoat Corporation | Flygt Corporation | Pomone Terre-Cotta Co 30 & 31 |
| American Bridge | Ford Meter Box Company, Inc | Portland Coment Association 49 |
| Division of United States Steel | Ford Motor Company | Preload Company |
| American Cast Iron Pipe Co 6 | Tractor & Implement Div. | Price Brothers Company |
| American-Marietta Co 70 | Ford Motor Company 64 & 65 | Public Works 173 |
| Concrete Products Div. | Forneys Inc 172 | |
| American Playground Device Co 54 | Frink Sno-Plaws Inc | Recordak Corporation |
| Auburn Machine Works, Inc 54 | Frink Sheriews Inc | Reo Motor Truck Division |
| Aurera Pump Division | Gar Wood Industries, Inc | White Motor Company |
| Automatic Signal Division | Gojer, Inc 68 | Ridge Tool Company 72 |
| Eastern Industries, Inc. | Good Roads Machinery Corp 138 | Roberts Filter Mfg. Co 44 |
| Ayer-McCarel Clay Co., Inc 30 & 31 | H | Roof Manufacturing Co 68 |
| Bouches Manufacture & 1 | Hamilton Kent Mfg. Co | Rynel Corporation 50 |
| Baughman Manufacturing Co., Inc 141 | Healy-Ruff Company 42 | Sanfax Corporation |
| B-I-F Industries | Heil Company | Schield Bantam Company |
| B/W Controller Corp 176 | Hersey-Sparling Meter Company | Schramm, Inc |
| Bowerston Shele Co | | Simplex Valve & Motor Co |
| Buffelo Meter Co., Inc | Hotel Tuller | Smith & Lougland |
| Buffalo Pipe & Foundry Corp 146 | Hough Company, Frank G 66 & 67 | Smith & Laveless |
| Cannelton Sewer Pipe Co 38 & 31 | Hydepak Division | Sprague & Henwood, Inc 42 |
| Case Company, J. I | Hydro E-Z Pack 159 | Standard Steel Works Inc |
| Cast Iron Pipe Research Assec 8 & 9 | Division of Hercules Galian Products, Inc. | Steiert & Sens, Inc 170 |
| The state of the s | | Sutorbilt Corporation |
| Caterpillar Tractor Company 4, 24 & 25 | International Harvester Company . 28, 29 & 77 | Synchro-Start Products, Inc |
| Chain Belt Company 75 | Irving Subway Grating Co., Inc 38 | Synchro-Start Products, Inc |
| Chevrolet | Jacobson Manufacturing Company 78 | Terrent Mfg. Company 44 & 177 |
| Chicago Bridge & Iron Co Third Cover | Jaeger Machine Company 54 | Texas Vitrified Pipe Co |
| Chicago Pump Company | Johns-Manville | Trickling Filter Floor Institute 30 & 31 |
| Clark Equipment Company | Johnson Gear & Mfg. Co., Ltd 170 | Trojan Manufacturing Co |
| Construction Machinery Div. | | Truce Masonry Drilling Div |
| Classified Advertising | Kerrigan Iron Works Company | |
| Cleveland Trencher Company | Keasbey & Mattison Company 82 & 83 | U.S. Pipe & Foundry Co 26 & 27 |
| Clew & Sens, Inc., James B 32 & 33 | Komline-Sanderson Engr., Corp 143 | United States Steel Corp 80 & 81 |
| Computer Measurements Co 52 | LeTourneau-Westinghouse Company 137 | |
| | A Subsidiary of Westinghouse Air Brake Co. | Vermeer Manufacturing Company 132 |
| Deere, John 21 | Link-Belt Company 167 | Wallace & Tiernan Co., Inc Back Cover |
| Deming Company | M-B Corporation 142 | Warner & Swarey Co.—Hopto |
| Dempster Brethers 162 & 163 | M & H Valve & Findings Co 168 | Wedge-Lack Clay Pipe Mfgrs Second Cover |
| Diamond Crystal Salt Company 12 | McConnevehov, K. E | Weil Pump Company |
| Dickey Clay Mfg. Co., W. S 30 & 31 | | Wheel Trueing Tool Co |
| Dorr-Oliver, Inc | McGowan Pumps | White Diesel Engine Division |
| Dow Chemical Company 128 | Mire-Flax Company, Inc | The White Motor Company |
| Dresser Manufacturing Division 149 | Modern Products, Inc | Whiting Company, E.B. & A.C 22 |
| Drott Manufacturing Corp 28 & 29 | Marse-Boulger Inc 170 | Wilkinson Products Co 143 |
| Earthworm Boring Machine, Inc 44 | Mueller Co | Wood Company, R. D |
| Electric Machinery Mfg. Company 20 | Multiplex Mfg. Co | Woodward Iron Company 59 |
| Equipment Engineers, Inc | | Wyandotte Chemicals Corporation 48 |
| Evenite Plastic Company | Natco Corp 30 & 31 | Michigan Alkali Division |
| Evens Pipe Company | National Clay Pipe Mfgrs., Inc | W S-i & Mile Committee |
| | Neenah Foundry Co | Young Spring & Wire Corporation 175 |
| Division of General Mators 135 | Orangeburg Mfg. Co | Zep Manufacturing Corp 61 |
| | INC ENGINEERS APPEAR ON BAGES | |

CONSULTING ENGINEERS APPEAR ON PAGES 178 to 183

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California Highway Patrol parking lot becomes an airport during recent tests of Hiller helicopter for patrol duty along Nimitz Freeway. Accidents showed a 66 percent drop during the test period.

Shopping center in Omaha, Neb. is brightened by Westinghouse mercury vapor lamps mounted on top of tapered square steel poles of Valley Mfg. Co.



Spanning Lake Washington Ship Canal, this dual truss-type bridge in Seattle, Wash., fabricated by Allied Structural Steel Co., is major link in 65-mile freeway section.

WORTH SEEING



A "snow gate" fabricated by the City of Anchorage, Alaska attaches to PTO of motor grader where it is lowered to hold snow if passing driveway openings.



This Parsons Trenchliner solved dirt handling problem on sewer job inside of 10 foot wide roadway right of way.





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by Arthur K. Akers

- ★ At R. D. Wood Co., Philadelphia, Wesley Davis replaces Frank Harmstad, retired, as manager of valve and hydrant sales.
- ★ Lock Joint Pipe Co. forms a new plastics division under R. J. Sweitzer and acquires Electro Chemical Engineering & Mfg. Co. of Emmaus, Pa.
- ★ S. James (Jim) Duncan moves up with International Salt Co. to manager of highway technical service. His headquarters remain in Detroit. A. Stuart Hunter is promoted to succeed him, at Clarks Summit, Pa.
- ★ United States Pipe & Foundry Co., Birmingham, establishes four new sales offices: Nashville 12, Tenn., under Earle R. Evans; Oklahoma City 6 under James W. Crawley, formerly at Kansas City; Abilene, Texas, under Cleo C. Whitlock, formerly water and sewer superintendent, City of Abilene; and Santa Fe, N.M. under James W. Wilson.
- ★ Recordak Corporation, New York, (Eastman Kodak subsidiary) promotes Raymond F. Beckwith to advertising manager, succeeding O. H. Perry Cabot. John P. Eager, of Chicago becomes sales manager.
- ★ Kenneth C. Dorland is new general sales manager, The Union Metal Mfg. Co., Canton, Ohio, lighting standards and traffic signal poles.
- ★ Henry N. Armbrust moves up to systems engineer in charge of vacuum diatomite filters for water applications, B-I-F Industries, Providence.
- ★ We step slightly aside to welcome **Eric Johnson** as new director of the AWWA Advancement Program. He continues responsible for publication activities and some administrative matters.
- ★ Pi-Pet Chemical Corp. has been organized at 295 Madison Ave., New York 17, to market asphalt from certain midwest and east coast plants. John A. Raggio, formerly

- with Pioneer Asphalt Div., is its president.
- ★ Layne Associates, Memphis 8, is a new organization "to promote progress in the development and conservation of water supplies"— and to provide technical information in that field. John M. Proos, chairman of the board, Layne & Bowler, Inc., will be executive secretary.
- ★ U. S. Concrete Pipe Co., Cleveland, names H. M. Saalfield general sales manager; J. Donald Anderson, manager of sales promotion.
- ★ Julius G. Kern, Jr., of Birmingham,, joins Eimco Corp. Tractor-Loader Sales as New York District manager.
- ★ Edward B. Carey appointed director of marketing for Dresser Mfg. Div., Bradford, Pa.
- ★ Shunk Mfg. Co., Bucyrus, Ohlo, makers of blades and cutting edges for earthmoving equipment and snowplows, has been acquired by Chromalloy Corp., to be operated as a wholly-owned subsidiary.



Mr. Pfaff

* Henry Pfaff, president of Pfaff & Kendall, Newark, N. J., announces that that firm has absorbed Traffic and Street Sign Company, and will continue

their manufacture of all street and traffic signs, lighting standards, and related products under the P&K organization.

- ★ John P. Henebry fills the newly created position of director of the Water Division of Fairbanks, Morse & Co., marketing machines for desalting seawater.
- ★ Philip A. Jenks appointed director of sales, "Quick-Way" Truck Shovel Co., Denver.
- ★ There must be something the Russians didn't invent—or that the Japs could not make cheaper. Hersey-Sparling METROGRAM

HORTONSPHERES help reduce operating costs at South Bend treatment plant

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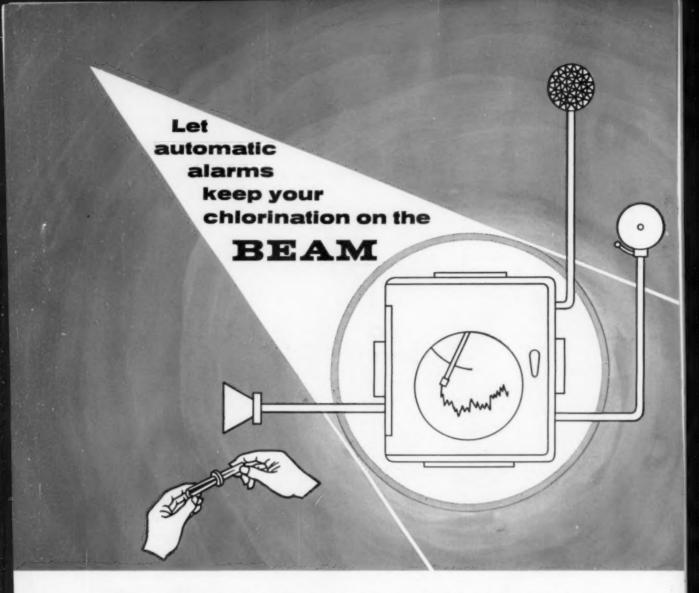
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